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THE EFFECT OF A CERTIFICATION PROGRAM FOR NURSES ON THE ACCURACY OF THE GLUCOSE OXIDASE PROCEDURE

BY

KATHLEEN L. O'NEILL

©

A THESIS

SUBMITTED TO THE FACULTY OF GRADUATE STUDIES AND
RESEARCH IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR THE DEGREE OF MASTER OF NURSING

FACULTY OF NURSING

EDMONTON, ALBERTA
SEPTEMBER, 1988

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The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies and Research for acceptance, a thesis entitled "The Effect of a Certification Program for Nurses on the Accuracy of the Glucose Oxidase Procedure" submitted by Kathleen L. O'Neill in partial fulfillment of the requirements for the degree of Master of Nursing.

Janet C. Kerr
Supervisor

Kyung Bay

Dedication

This manuscript is dedicated
to the memory of my mother,

Margaret O'Neill (Doran)

who showed me by her example,
the meaning of hope and persistence
and to the memory of my father,

Patrick O'Neill

who by his intellect and by his scrutiny
instilled in me a lifelong
desire to pursue knowledge and truth.

Abstract

The purpose of this study was to examine nursing accountability through testing a nursing procedure. The procedure was the measurement of capillary blood glucose using the visual chemstrip technique. Since clinical decisions are made based on the results of these recordings it is essential to establish the consistent accuracy of this method. Several studies have documented increased accuracy with the establishment and maintenance of educational programs. It was the intent of this study to determine the effects of such a program on the accuracy of this procedure by staff nurses.

An experimental research design was utilized. A total of seventy nurses and one hundred and twenty-three patients consented to participate. The site of the study was the medical unit of a large metropolitan hospital. The seventy nurses were randomly assigned to experimental or control groups. A certification program for the visual chemstrip procedure was provided to the nurses in the experimental group. All of the nurses in both groups then, performed two chemstrips each on patients who had blood glucose tests ordered. The chemstrips were performed within one minute of the laboratory staff drawing the blood sample. At the end of the data collection period, there were seventy chemstrip recording and seventy concurrent laboratory recording in the experimental group, and sixty-eight chemstrip recording and sixty-eight concurrent laboratory recording in the control group.

Simple regression analysis and the t test were used in the data analysis. The results supported the hypothesis that nurses who have successfully completed a certification program show more accurate results than those nurses who have not completed the certification program ($\alpha = 0.01$). Results of the study pointed out the need for careful scrutiny of new procedures which are added to the responsibility of the nurse. It is also clear that planning for educational programs to support the introduction of new procedures is required.

Acknowledgements

I wish to express my deep and sincere appreciation to Dr. Janet Kerr for the guidance and support which she freely gave me over the course of this research project. I also sincerely thank Dr. Kyung Bay for his time and patience in assisting me with the statistical analysis as well as Dr. Don Young for his interest and support regarding the clinical application of this study.

I would also like to acknowledge the cooperation and assistance I received from the nursing and laboratory staff of the Misericordia Hospital as well as the cooperation of the patients who participated in the study. A very special thank you to Pat Ferguson, Sara Wright, and Dr. Jannetta MacPhail without whose support and assistance this research project would not have been possible. As well, I would like to acknowledge the medical unit supervisors Marg, Janis, Wanda and Rose and the nurse clinicians Diane and Elaine for faithfully responding to my many requests.

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CHAPTER I

The Effect of a Certification Program for Nurses on the Accuracy of the Glucose Oxidase Procedure

Introduction

Advances in science and technology and the resulting proliferation of information have had a profound impact on the practice of nursing. Consequently, the knowledge and skills required to practice nursing are appreciably different than what was needed even a few years ago. In many situations, the scope and the focus of nursing are shifting in the light of this change. Nursing is becoming increasingly specialized as practitioners struggle to become technically competent as well as psychosocially attuned to the patient. Further, nursing has been called upon to assume functions and duties which have been traditionally performed by members of other disciplines. In the midst of this change, the challenge for nursing is to respond, and change in a timely and appropriate fashion. Dolan et al (1983) make the point that nursing must build on past achievements and be creative and analytical in the development of new areas of knowledge for the delivery of health care.

Professional responsibility and accountability demand that methods and processes be established to ensure that the necessary knowledge, skills, and attitudes be acquired and maintained by the practitioners involved in this changing environment. Standards which are specific and measurable must be established to guide the practitioner and ensure optimum delivery of patient care. Consequently, this process must be linked to existing quality assurance and risk management programs to ensure the ongoing maintenance of established standards. Westfall (1987) declares that nursing standards and nursing quality assurance are inescapably linked and centrally based on the delivery of the best possible patient care.

The importance of nursing research throughout this process is underscored. In order to facilitate scientifically sound nursing practice, a unique body of knowledge which is used for the care of the patient must be established and maintained. This body of knowledge can only be developed through research activity, and the new knowledge may subsequently be utilized to develop and refine standards and measures of competence and quality. Hinshaw (1977) predicts that one of the primary strategies for bringing about change beneficial to patient care is evaluation and demonstration of the outcomes of nursing care, a natural part of the scientific or research process in nursing.

The importance of practitioner competence in both the performance and outcomes of nursing procedures and techniques is well recognized. Flaherty (1979) suggests "the ideal of master craftsman as involving more than simply doing things well; it requires knowledge and understanding of the principles on which theory is based as well as the ability to apply these in the practice of the profession" (p. 22). The response of the nursing profession to the challenge of measuring competence has been varied. Such concepts as performance checklists (McCaffrey, 1978; Scott, 1979), criterion-referenced measurement (Krumme, 1975; Rogers, 1976), competency-based learning (Spady, 1977; Scott, 1982), and credentialing and certification (Vezina, 1984; Pick, 1984; Levesque, 1985, and Calkin, 1988) have been described in the literature. As well, guidelines and policies are being established in respect of the delegation of medical and other functions to nurses (Alberta Joint Guidelines for Medical - Nursing Responsibility, 1987; CMA Guidelines for the Delegation of a Medical Act, 1988). Clearly, the current trend is in the direction of credentialing and certification for measuring and recognizing nursing competence and patient outcomes. Furthermore, the process of certification is linked with existing quality assurance programs to ensure the ongoing competence of practitioners as well as quality of care for the client.

In addition, as technology continues to advance, those in health care are increasingly faced with the professional and ethical dilemmas resulting from a declining health care dollar and an increasing demand for service and specialization. The challenge includes the provision of the best possible health care and service in the most cost effective manner. Keil and Widmann (1984) question whether the introduction of many new technologies are of real benefit to the patient suggesting that some may simply represent a desire on the part of the user for the latest technological innovation. Consequently, it becomes vital for decision makers in health care to carefully scrutinize new technologies in the light of this cost-effective, quality factor.

It is within the context of quality of practice and professional accountability that this research project was generated. The intent was to examine the accuracy of a specific nursing procedure and to determine the effect of a certification program on the accuracy of this procedure. Results of the research project could assist in the development of standards for the procedure as well as promote linkage to the existing quality assurance framework.

Background to the Research

A function which has been transferred from the laboratory setting to inpatient and outpatient hospital settings is the measurement of serum glucose with glucose oxidase strips. Although nurses have been performing this function for some time, in many situations, measures have not been instituted to monitor the ongoing accuracy of the procedure. There has been concern about this as critical clinical decisions such as the ordering of insulin dosage and/or the administration of intravenous solutions containing calories are been made based on the results of the glucose oxidase strip procedure.

In one 550 bed hospital, nurses began performing this procedure in 1983 and are now performing 400-450 glucose oxidase procedures per week. When nurses began to carry out this procedure, an educational program was administered to all the nurses involved. Moreover, there has been periodic review of the procedure, and new staff nurses have been given the educational program as a part of their orientation. However, there has been no process established to monitor the ongoing accuracy of the procedure. As well, there is reason to be concerned about the lack of a monitoring program as several random spot checks of the accuracy of the chemstrip as compared to a laboratory blood glucose value have indicated less than desirable results (Study Hospital: Quality Assurance Audit, September, 1986). Further, several clinical situations have occurred that have led to questions about the accuracy and effectiveness of the present method. These situations have involved patients who received doses of insulin based on a chemstrip result indicating hyperglycemia; these patients subsequently developed insulin shock and concurrent laboratory glucose values indicted hypoglycemia. Therefore, in view of the real and perceived deficiencies of the existing system for capillary blood glucose monitoring it seemed essential to investigate the procedure and patient outcomes thoroughly.

Purpose of the Study

This study represented an effort to investigate the process for ensuring the establishment and maintenance of a safe and accurate chemstrip procedure in a specific hospital. The framework used to establish this process was the existing quality assurance program of the study hospital. The literature suggests that in general, systems which have been developed for capillary blood glucose monitoring are reliable when adequate education and frequent usage are present (Williams et al; 1984 Hilton, 1982; Godine, 1986). Based on available literature as well as experience, a certification program for the glucose oxidase procedure was developed, (Appendix A) administered and tested in the course of this research.

Objectives of the Study

1. To determine the current level of accuracy of staff nurses' performance of the glucose oxidase procedure on four medical units in the study hospital.
2. To determine the effects of a certification program for nurses on the accuracy of the visual glucose oxidase procedure on four medical units.

3. To assess the effect of time differentials between the certification date (educational program) and the chemstrip test date on the accuracy of the visual chemstrip procedure.

Hypothesis

Staff nurses who have successfully completed a certification program (experimental group) will show more accurate chemstrip results than those staff nurses who have not received the certification program (control group).

Definition of Terms

Staff Nurse: A registered nurse employed in one particular general hospital who cares for the patient at the bedside.

Chemstrip bG: The trade name for a method of capillary blood glucose monitoring using test strips manufactured by Bio-Dynamico lot number 208683. In this study, strips are read visually.

Laboratory Glucose Method: The method of glucose testing used by the hospital laboratory. The method involves an enzymatic electrode which measures oxygen release by glucose and is called the Astra 8 method.

Certification Program for Chemstrip Procedure: The program which was utilized for purposes of this study is a program developed at the particular hospital where the study was conducted based on available literature and experience. The program is attached as Appendix A.

Ethical Considerations

Professional and hospital ethical principles were adhered to and ethical clearance was obtained from the University of Alberta Faculty of Nursing Ethics Review Committee. Permission to proceed with the study was received from the hospital Research Ethics Committee. Written consent was obtained from all registered nurses participating in the study (see Appendix B). Nurses were given a thorough explanation of the project prior to the request for consent to participate in the study. The participants were assured that anonymity would be maintained in relation to individual results. It was also explained that non-participation would not in any way affect their employment status and that they were free to withdraw from the study at any time. An explanation was given to all patients involved in the study requesting their written consent to participate (See Appendix C). Nurses and patients were informed that the study was being done to compare the results of a laboratory blood glucose ordered by the physician with those of a corresponding chemstrip done at the same time by the nurse. The participants were also instructed that the purpose of the study was to determine the effects of an educational program on the accuracy of nurses' performance of the chemstrip procedure. Patients were advised that participation in the study was completely voluntary and would not affect their ongoing care and treatment in hospital in any way.

Limitations of the Study

Since it is thought that accuracy in the performance of the chemstrip procedure is likely to be related to the number of opportunities to perform the procedure on an ongoing basis, generalizability of study results is limited to those areas of the study hospital where nurses perform relatively high numbers of tests on a regular basis.

CHAPTER II

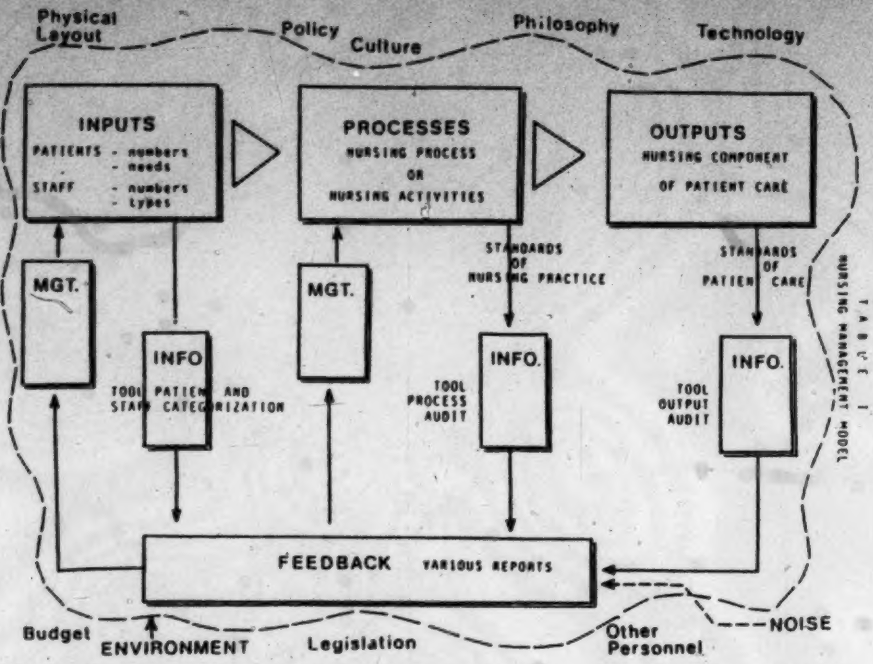
Literature Review

Conceptual Framework

From a global perspective this research endeavour deals with ensuring quality control in the performance of a nursing procedure. Specifically, concepts such as determining levels of quality, standards of care, risk management, nursing competence and patient care outcome are addressed. To ensure a systematic and effective approach to this research activity all of these concepts needed to be linked together in an integrated fashion. A framework was needed to guide the research process as well as providing a way of integrating the knowledge gained in applying the research findings. It seemed appropriate from a practical point of view to utilize the quality assurance framework which existed in the study hospital.

The framework utilized in the study hospital for the quality assurance program is an adaptation of general systems theory. The concepts of general systems were first discussed in the 1920's and formalized into theory in the 1950's and 1960's. Boulding (1968) referred to general systems theory as the skeleton of science, a body of theoretical constructs which serve to express general relationships of the empirical world. Klir (1972) discussed systems theory as a collection of general concepts, principles, tools, problems methods, and techniques associated with systems. Von Bertalanffy (1968) further described it as an exploration of wholes and wholeness; interdisciplinary in nature and a possible approach to the unification of the sciences. Thus, general systems theory perceives living systems as open systems which are maintaining themselves or moving towards equilibrium or a steady state. The basic concepts include; entrophy or the belief that a closed system will gradually increase in disorganization and randomness until death occurs, evolution or the dynamic process of increasing complexity and higher organization, equifinality or the implication that sameness of end can be reached in all open systems, multi-finality or the belief that end states have varying possibilities, feedback in which the output of a system is redirected as input to allow the system to correct itself, and control of sub-systems which is the belief that one part of the system must emerge as the controlling unit capable of integrating the actions of the sub-parts of the system. Thus the process of general systems allows for the integration of the total organism and the possibility of unified action.

The study hospital has identified and explicated the major components of their quality assurance model as inputs, process, and outputs.


Physical Layout
Policy
Culture
Philosophy
Technology
INPUTS
PATIENTS - numbers - needs
STAFF - numbers - types
PROCESSES
NURSING PROCESS OR NURSING ACTIVITIES
OUTPUTS
NURSING COMPONENT OF PATIENT CARE
MGT.
INFO
TOOL PATIENT AND STAFF CATEGORIZATION
MGT.
STANDARDS OF NURSING PRACTICE
INFO.
TOOL PROCESS AUDIT
STANDARDS OF PATIENT CARE
INFO.
TOOL OUTPUT AUDIT
TABLE I
NURSING MANAGEMENT MODEL
FEEDBACK VARIOUS REPORTS
Budget
ENVIRONMENT
Legislation
Other Personnel
NOISE

Quality Assurance Model Study Hospital, 1979

Inputs are defined as human and material resources which are available which include parameters such as the patient needs and desires, as well as the staff skills, attitudes and knowledge. Applying the criteria of input to this specific research project includes the discussion of factors such as the administration of the certification program to the experimental group, the consent and participation of the patients, as well as nurses' consent and participation in the study.

The second component of the hospital quality assurance model is defined as process and includes the steps of the nursing process as well as other activities such as documentation of the medical record and interdisciplinary communication. In relation to this study, factors such as the importance of interdisciplinary communication between nursing and laboratory staff members in the timing of the post-test as well as proper documentation of the results of the chemstrip and the laboratory values can be included in this component.

The third element of the hospital model is outputs. Outputs are defined as results, goals or outcomes to be achieved in relationship to nursing activities. Further, outputs can be defined as the quality of the nursing component of patient care. Relating the component of outputs to the factors identified in the study one can include concepts such as nursing competence and patient care outcome. For example, the actual measure of the nurses' performance of the chemstrip as compared to the laboratory measure will be included in the output component of the quality assurance paradigm.

An activity which can flow from this study is the establishment of a quality control program for capillary glucose monitoring. With the information gleaned from the study, decisions can be taken relative to the need for extension of the certification program to other nursing units as well as the incorporation of a system which would ensure the ongoing competence of the nursing staff in the performance of the chemstrip procedure. A collaborative effort on the part of nursing and the laboratory personnel is necessary for such a program to be effective. In effect, the quality assurance model of the study hospital can be used for this activity. The inputs would include the review of information and skill level necessary as part of the recertification process. In relation to process criteria, such factors as the implementation of policies and procedures for the chemstrip procedure and the performance and monitoring of regular controls to determine ongoing accuracy of the procedure are included. The output components include compliance to standards of practice and standards of care for the chemstrip procedure as well as the actual determination of the ongoing accuracy of the procedure.

One can ascertain then, how the systems model and more specifically, how the hospital quality assurance model, can link the components of this study together in a logical fashion. This then will ensure an integrated and consistant methodology in relation to the conduct of the study as well as the maintenance of the quality control program which ought to flow from the study. Thus the unifying element which emerges from the model is the common goal of all subsystems which is to promote and maintain quality of patient care.

Technology and Nursing

The impact of escalating technology on the practice of nursing is receiving increasing attention in the literature. There is considerable discussion of the effects of science and technology in creating highly specialized fields which in turn demand enhanced and diverse educational preparation for nursing practitioners (Leininger, 1978; Hockey, 1981; Dolan,et al 1983; Dolphin & Holtzclaw, 1983; Pick, 1984; Banning, 1986; Gataint, 1987; Christman, 1987; Calkin, 1987). With increasing specialization, demographic changes, and technilogical advances an increasing complexity and nature of nursing care is required (Dolan, et al 1983; Dolphin & Holtzclaw, 1983; Flynn, 1984; Aydelotte, 1987). Further, it is crucial in this highly technological environment for nurses to be very sensitive to the psychological and emotional needs of the people they serve (Watson, 1979; Kerr, 1983; Cox, 1985; Shaver, 1986; Gataint, 1987).

There is increasing discussion of the importance of caring for the patient in a wholistic fashion in order to facilitate the healing process and thereby, accomplish the mission of nursing (Cox, 1985; Holmes, 1984). Health care professionals are struggling to come to terms with role changes and there is some evidence of role conflict between and among professionals during the transition as they compete for patients' time and attention (Kerr, 1973;

Aydelotte, 1978; Davidson et al 1981; Hockey, 1981). From the patient's perspective, perceptions of being treated as a part or a subsystem rather than as a whole have been expressed (Rogers, 1970; Holmes, 1984; Ginsberg, 1982). Moreover, many moral and ethical dilemmas are surfacing as technology outpaces society's readiness to deal with its outcomes (Davis et al 1978; Farmer, 1981; Storch, 1982; Cox, 1985). Gataint, (1987) describes the current complex scene which includes organ transplants, electronic monitoring, test tube babies and medical information systems with the tremendous moral and ethical ramifications which result from these technologies. In summary, advances in science and technology have had tremendous impact on nursing practice and patient care and it is clear that this trend will continue. In many situations great benefits to patients have been achieved; however, nursing must be constantly vigilant and sensitive towards potential areas of concern relative to the care recipient.

Response of Nursing

Generally the response of nursing to the technological revolution in health care has been to expand the knowledge base of the practitioners to accommodate the new technologies. Because of the ongoing expansion of the role and functions of the nurse, the issues raised are being diligently examined as nursing leaders and theorists attempt to reach consensus on an agreeable definition of nursing which in turn will identify the unique role of nursing (Johnson, 1959; Roy, 1976; Henderson, 1978; Rogers, 1980; Orem, 1980; King, 1981; Conway, 1985; Scholotfeldt, 1987). Further, discussion and debate are taking place on such concepts as technical versus professional functions as well as generalist versus specialist roles as nursing struggles with the complex task of preparing to meet the nursing needs of the 21st Century (Leininger, 1978; Murphy, 1978; Hockey, 1981; Pick 1984).

The need for highly technical nursing skills has fostered the emergence of roles such as nurse practitioner and clinical nurse specialist. These individuals are clinically and academically prepared to be experts in their fields and are charged in part with the responsibility of developing others to become experts (Boone and Kikuchi, 1977; Donaldson and Crowley, 1978; Ford, 1979; Sovie, 1981). Furthermore, the demand for technical competence has been exacerbated by the assumption of functions by nursing which were once considered medical practice. With this expansion in the role and scope of nursing, structures and processes have had to implemented to ensure compliance to minimum professional standards and to address legal perspectives (Kerr, 1973; Storch, 1982; Creighton, 1987).

One of the outcomes of the debate, at least provincially, has been a change in existing government legislation. For example, in 1984 the Alberta Nursing

Profession Act was enacted, changing the previous legislation to reflect more accurately the current status of nursing in Alberta. The principal object of the new Act was to describe the practice of nursing and to define an exclusive scope of practice, thereby giving nurses the right to practice nursing as defined (Elliot, 1984). Furthermore, joint task forces of concerned groups have developed guidelines for medical-nursing responsibilities for the purpose of assisting health care agencies to uphold their responsibility in the development of local policy and procedure to ensure nursing competency and safe levels of patient care (AARN, College of Physicians & Surgeons and AMA Guidelines for Medical Nursing Responsibility, 1987). This process includes provision for a knowledge, skill testing and evaluative component to ensure ongoing nursing competence.

Measurement of Nursing Competence

Various techniques have been discussed respective to the measurement of nursing competence and patient care outcomes; some have been more successful than others. The concept of "competency based learning" as described by Spady (1977) is a process which measures records, and certifies within a flexible time frame the demonstration of learning outcomes. "Criterion referenced evaluation" is aimed at measuring success by the meeting of predetermined objectives (Krumme, 1975; Rogers, 1976). A process described by

McCaffery, (1978) and Scott, (1972) and designed to elicit learning needs by the checking off of items by respondents results in "performance checklists". The techniques described have to a degree been successful in the measurement of the specific attribute which they were designed for.

The current focus in the literature aimed at a more global measurement of nursing competence seems to be slanted towards credentialing and certification programs (Vezina 1984; Pick 1984; Levesque 1985; Harris, 1986). Credentialing mechanisms have been designed to assure quality care for the public with the most generally recognized being accreditation, licensure, certification and academic degrees (A.N.A. 1979 pp. 33-40). Certification, as defined by Drew (1984), is a process whereby a non-government agency or association validates based on pre-determined standards an individual registered nurse's qualifications, knowledge and practice in a defined functional or clinical area of nursing. Generally the certification process includes a written examination, validation of experience in the field of practice and a periodic review and evaluation of knowledge and competence (Vezina, 1984; Drew, 1984). The process of recertification assures continued competence within specialized nursing practice. The time frame is regulated by the specific certifying group and can be anywhere from one to five years

(Vezina, 1984). Certification programs have also taken on new meaning. For example, there is increasing recognition of certification as a criterion for placement and advancement with clinical career pathway programs. Certification according to Vezina (1984) is defined as the acknowledgement of those individuals who have attained a specific level of knowledge in an area of nursing specialization; thus the nurse can use certification as a means to expand career options. Scrima (1987) has described a method for assessing staff competency from the period of hire throughout employment. The author describes the use of a framework for internal credentialing which provides a consistent and structured method of documenting clinical proficiencies to facilitate the achievement of individual learning needs. The framework consists of the following components; internal interview, performance standards, remedial study, maintenance of competence, and certification (Scrima, 1987).

Certification has gained increasing acceptance as a standard for competent nursing practice, role identity, and accountability. It also serves as a protection for the consumer of health care by ensuring acceptable standards of patient outcomes (Drew, 1984). The American Nurses Association has gone on record as supporting the concept of credentialing and certification. In 1976 ANA appointed a Committee for Study of Credentialing in Nursing (SCN) and this committee concluded in 1979 that "certification for specialty practice by a non-governmental agency or association has the greatest potential for assuring the welfare of the public and for standardizing the qualifications for and quality of speciality practice across the nation" (ANA report on the study of credentialing in nursing 1979, p. 679). The Canadian Nurses Association (CNA) policy on credentialing in nursing is one of support, recognition and commitment. The association supports in principle current credentialing practices and recognizes that each credential serves to some degree the function of protecting the public. The CNA is particularly committed to promoting the development of certification of clinical and functional nursing specialities in Canada (Pick, 1984 p. 23). Hence, certification becomes a desirable and attainable goal for nurses in a variety of practice settings. It is a concrete way to ensure professional accountability and role identity.

Effect of Education on Performance

McCloskey (1981) presents an overview of the literature on the effectiveness of nursing education as it relates to job performance. Selected literature was divided into three areas of study, competence, performance, and quality of care. The findings demonstrated a lack of rigorous research in this area; suggested certain directions including the measurement of individual rather than group performance, the development of better measuring instruments, and control of the setting and individual variables that affect job performance. It was also recommended that nursing effectiveness be defined in terms of both patient outcomes and nursing performance. A study performed by Meservy and Monson (1978) evaluated the impact of continuing education on nursing practice and quality of care. It was concluded that continuing education did improve the quality of nursing practice and patient care; further, the study documented increased nursing awareness, greater interest in quality patient care, more sophisticated measurement of care, more positive staff attitudes, improved hospital climate, consensus of nursing personnel that patient care had improved, increases in audit scores and increased interaction and interventions with patients.

Turner (1987), discussed the best methods of teaching cardio-pulmonary resuscitation (CPR) and the following principles were identified from the literature; proceed from the simple to the complex, teach skills in the order that they are used, deal with one technique at a time, employ continual reinforcement, practice overlearning, integrate cognitive and psychomotor learning and encourage confident employment of CPR skills. A study by Megal et al (1987) examined the skill of parenteral medication administration comparing laboratory proficiency to clinical proficiency over time. Subjects were 35 associate degree nursing students. There was no significant difference in the number of errors between the laboratory "check out" and the first clinical performance nor was anxiety related to skill performance. Davis (1987), compared the effectiveness of two teaching methods for neurological assessment and it was discovered that the efficacy of both the videotape presentation and the lecture demonstration was supported by study results; this was in keeping with previous findings.

Measurement of Patient Outcomes

If nurses perform well, it ought to follow that patients will receive quality care. However, there have been few attempts to measure patient care outcomes. Although there are instruments available, little use has been made of these instruments. Some of these instruments include; the Horn and Swain Criterion Measures of Nursing Care Quality for measuring the quality of nursing care through patient outcomes (National Centre for Health Service Research 1978), the Phaneuf Nursing Audit for Measuring the quality of nursing care received by a patient after a cycle of care has been completed and the patient discharged (Wandelt & Phaneuf, 1972) and the Wandelt and Ager Quality Patient Care Scale for measuring the quality of nursing care received by a patient while care is in progress (Wandelt & Phaneuf, 1972). McCloskey (1981), suggests that quality of nursing care is difficult to define in terms of patient outcomes. The author points out that quality of care may be judged by an improvement in the patient's health condition or in the patient needs, and satisfaction, two aspects which may not be mutually exclusive. Second, most nurses work in group situations where no individual nurse can be held accountable for the overall nursing care a patient receives. Finally, patient outcomes are affected not only by nursing personnel but also by the work of other professionals, setting, available equipment and the patient's background and resources. The current trend, in relation to the measurement of both nursing competence and patient outcomes is in the development and measurement of standards of practice and standards of patient care (McCann, 1984; Beckman, 1987; Westfall, 1987).

Standards

Standards are defined by McCann-Flynn (1984) as the basic framework of accountability. The author elaborates by indicating there are two basic elements used in development of standards and these are criteria and norms. Criteria are rules for performance and degrees of achievement of the expected outcome. Norms are predetermined expected levels of performance or achievement. Poe and Will (1987) describe standards as a means by which nursing care and patient care can be evaluated. Two types of standards are described; standards of practice and standards of care. Standards of practice focus on the nurse as the care provider and provide staff nurses with a guide to that practice. Standards of practice are operationalized through policies, position description and performance standards. Standards of care shift to the care recipient and are directed at achievement of specified patient outcomes. They provide nurses with a guide for patient care and are operationalized through procedures, protocols and care plans (Poe and Will, 1987). A different approach to standards is explained by Beckman (1987). A standard is defined as a statement of value that includes the criteria and level of achievement by which practice can be judged. All standards are defined as practice standards, but sub-categories of structure, process, and outcome are developed which may be derived from systems theory (Donabedian, 1982). Structure standards describe desirable conditions that allow or provide for quality of care, process standards refer the desirable practices that should take place in the care process; and outcome standards are the desirable end results, the health status, knowledge, performance or other characteristic of the patient that is expected as an outcome of the care (Beckman, 1987).

Professional associations have shown leadership in the establishment of nursing practice standards. For example, in 1973 the American Nurses Association accepted and published eight generic clinical practice standards to lay the foundation for professional nursing practice (A.N.A. Standards, 1973). The Alberta Association of Registered

Nurses (AARN) in 1980 established and published six generic nursing practice standards which were deemed essential for the following reasons: to permit assessment of present nursing practice; to assist with quality assurance; to enable the consumer to judge the adequacy of nursing care; to provide guidelines for setting the terminal objectives of educational programs in nursing; to provide guidance to researchers in identifying relationships between nursing practice and patient care outcomes; and to promote the professional growth and development of nursing (AARN Nursing Practice Standards, 1980 p. iii). The standards of nursing practice developed by the AARN pertain to the process of nursing namely, assessing, planning, implementing and evaluating. Each standard is comprised of three sets of criteria. The first of these is structure which pertains to the environment within which nursing takes place; the second is process, pertaining to nursing actions and the third is outcome pertaining to the desired effect of nursing intervention on the patient (AARN Standards, 1980 p. iv).

There has been discussion of legal implications of establishing standards and the importance of establishment of standards which are attainable (Guarriello, 1984; Benner, 1984). As well, the necessity of operationalizing the generic standard into a specific measurable standard by the particular agency has been stressed by many authors (Beckman, 1987; Mason, 1984; Pelle, 1986; Block, 1977;

Westfall, 1987). From the literature it follows that if a profession is to be truly accountable it must develop and maintain its own standards and do so in a manner which is meaningful and beneficial for both practitioners and consumers. Furthermore, standards cannot exist in isolation - they must be linked to the quality assurance framework. In this way, standards will be a dynamic entity in the quest for excellence in nursing practice and patient care.

Quality Assurance

Many authors suggest that quality assurance programs and the effective monitoring of these programs present an ongoing challenge to nursing departments. Quality assurance encompasses a collection of all activities that come together to ensure the best possible care. Westfall (1987), suggests that a quality assurance program provides a framework for nursing activities. Thus, standards occupy an integral place in the quality assurance paradigm. Pelle (1987), proposes that quality assurance programs are designed to establish and monitor standards of professional practice and ensure through continuous measurement and evaluation of structural, process and outcome components that these standards are met. Nursing professionals are increasingly concerned about the quality of care being delivered and Wilson (1986) believes quality assurance is a part of a larger systematic program aimed at ensuring that patients receive a specific level of care. This is achieved by monitoring characteristics of the system such as the activities carried out in providing nursing care and those patient outcomes associated with nursing which then result in decision making, problem solving and changes in practice. Schroeder and Mainbush (1984) suggest that quality assurance begins with development of standards which represent accepted measurable levels of excellence. In the analyses of quality nursing care, nursing practice standards are broken into measurable components of structure, process and outcomes framework (Schroeder and Mainbush, 1984).

In the introduction of new technology there must be a control system in place which will monitor the effect of the new technology on the quality of care. Pelle (1987) points out that nursing administrators will be required to assume increasing accountability for the quality and cost of nursing services provided. Therefore, they must be acutely aware of any change in the health care environment and the impact of that change on nursing practice. Keil and Widmann (1984) suggest that health care facilities should ensure that a newly acquired technological instrument does not pose safety hazards to the patient, that the device produces the desired end results reliably and consistently, that there are appropriate means of identifying performance defects and that the quality of the device does not deteriorate due to equipment obsolescence. The authors go on to suggest that successfully applying quality assurance principles consistent with each phase in the life of medical technological devices should ensure the use of equipment of high quality, thus benefiting patient care. This would include the formulation of acceptable and specific standards in relation to the new technology.

Further, a concept called risk management is presently being widely discussed in quality assurance circles. According to Mills (1988), risk management is complimentary to quality assurance; risks are monitored throughout the agency and there is an attempt to minimize, prevent or eliminate risks. It is emphasized that evidence of such risks may appear in various agency reporting mechanisms such as safety committee, unusual occurrence, disaster exercise, infection control, mortality and morbidity, pharmacy and therapeutics, workers compensation, and union grievances to name a few.

In the climate of cost control and quality care of today it is crucial for nursing departments to ensure that quality assurance programs achieve their mission. Poe and Will (1987) assert that quality assurance programs that fail to do so are too costly. They go on to state that incoherent vocabulary, unclear goals, lack of consistency and questionable clinical relevance all contribute to a less than effective quality assurance program. Without consistent focus and meaningful direction many complex quality assurance systems may be clinically useless.

Discussion about general nursing concerns in relation to the need for cost efficiency in health care organizations is receiving a great deal of attention in the nursing literature. Nelson (1986) points out the importance of nursing input into financial decisions and opportunity for nursing to study costs associated with quality. Further Poe and ~~Will (1987~~) suggest that as the health care system strives for cost-containment and increased productivity, nursing departments must develop state of the art quality assurance programs which are linked integrally to the hospital-wide system and directed towards a well defined goal of quality. Pelle (1986) advocates the necessity for a unit-based quality assurance program which is integrated into the overall nursing service program including the ongoing monitoring of nursing practice. She also describes a move towards using outcomes measures as a basis for present and future health care quality measurement in response to an increasing desire to make decisions based on good information regarding quality. One of the most meaningful ways nursing outcomes can be measured is to compare them against established standards, in an ongoing clinical research program.

Nursing Research

Nursing leaders have long supported the necessity and importance of the carrying out nursing research and the need to utilize research findings in the practice setting.

Schlotfeldt, (1981) discusses the ethic of scientific enquiry within professional practice as being in order to specify explicit outcomes for which nursing would be accountable. Aiken (1982) suggests that nursing is a sleeping giant and predicts that one of the primary strategies for bringing about change and increasing nursing influence is evaluation and demonstration of the outcomes of nursing care. According to Hinshaw (1988), nursing is committed to research to provide information to guide and improve nursing practice. Fry (1981) suggests that nursing research provides a means by which theoretical constructs of nursing are tested and verified and the practice of nursing is improved. It is further asserted that in research settings the value assumptions of the standards of practice direct the way in which the scientific enquiry is structured.

The challenge for nursing today is to expand and utilize the evolving scientific body of knowledge. Schlotfeldt (1977) has called this commitment to research the key means by which nursing can live up to its potential. Gortner (1974) called for standards of scientific accountability as the means by which quality of nursing service will be improved. It has been predicted by Hinshaw (1988) that nursing's ability to use the growing body of knowledge will be greatly influenced by the quality of the research and the processes used for its generation and testing. This is because the findings from the nursing research program are a major resource for influencing and shaping health care policy; thus, it is essential that information from this research be accurate and reliable.

There has been considerable discussion of the importance of research in the quality assurance paradigm. However, in many situations, there have been inadequate structures and processes established to generate and test questions that arise in the practice setting and incorporate and disseminate the findings if appropriate. Poe and Will (1987) discuss the importance of scientific enquiry for purpose of measurement of quantity and quality of nursing practice and patient care and the validation of standards. Although nursing leaders agree that nursing practitioners should know about and use the most current nursing knowledge and technology, studies suggest this is happening only to a limited degree. Luckenbill-Brett (1987) surveyed 216 nurses to find if they were aware of 14 published nursing research findings and found that 61% of the sample indicated the research findings were used at least sometimes. Kirchhoff et al (1982) found that only 24% -35% of a sample had adopted one of two innovations she studied. Ketefian (1975) studied the oral temperature taking practices of 87 registered nurses following research findings which reported optimal placement time and discovered that only one of 87 nurses knew the correct placement time.

It is evident that although many in nursing are stressing the virtues of the development of a scientific base to guide practice, some nurses remain unconvinced if not unconcerned. It seems prudent for nursing to examine this dilemma. Notter (1978), believes that the gulf which exists between theory and practice will narrow as practicing nurses become familiar with research and its potential contribution to clinical nursing. Kikuchi et al (1982) suggests that successful incorporation of research in the clinical setting is attendant upon the sensitive task of ensuring safe and ethical conduct on the part of researchers. Morse and Conrad (1982) stress the importance of the study of research questions which arise in the clinical setting and define a process for the application of research to practice. Increased supervisory staff participation in all aspects of research was found by Davis (1981) to be one way of lessening the gap between nurses who conduct research and those who are clinical practitioners. Hunt (1981), points out that for nurses to be convinced of the merit of research it must to be useful to them in their practice. She cites an example where the problem was addressed by beginning with a review and updating of the procedure manual incorporating new knowledge and discontinuing that which was not relevant. The next step was to identify clinically relevant questions which arose from this endeavour, and study them.

Research testing nursing procedures

In a review of the nursing research journals there is an substantial number of research publications which deal with the testing of nursing procedure and techniques, some of which are relevant for review here. There are several studies which deal with temperature assessment. Schiffman (1982) investigated the difference between temperature taking in neonates by axillary and rectal methods and found a significant correlation between both methods indicating both were acceptable for monitoring neonatal temperature. The effect of oxygen administration on oral temperature assessment was studied by Hasler and Cohen (1982), and it was concluded that there was no difference between oral temperature with or without oxygen. Further, Jachovsky (1985) described and compared indirect auscultatory blood pressure measurement at the forearm site with values obtained at the traditional upper arm site and results indicated that statistically significant differences exist between the sites. Differences in mean arterial pressure readings with variation in position and transducer level was examined by Kirchhoff et al (1984). Results indicate that in stable patients mean arterial pressure (MAP) readings are comparable but in patients who are not stable there are differences.

Medication administration is another theme identified in the nursing research literature. Long (1982) studied the effect of medication distribution systems on medication errors; omission of medication was the most frequently reported at 28.4%, wrong dosage or wrong medication were recorded at 17.4% and errors in frequency was third at 14.9%. Faherty and Grier (1984) studied analgesic administration in the elderly and found that the older the patient, the less analgesic administered. In a clinical evaluation of three techniques for administering low dose heparin, Vanbree et al (1984) concluded that none of the three techniques appeared clearly superior in yielding smaller or fewer bruises. Poteet et al (1987) in examining the outcome of multiple usage of disposable insulin syringes found that 44.6% of 166 subjects reused their syringes; 4 syringes were found to be contaminated with normal skin flora and 15.1% of subjects did not wash their hands or clean the site prior to the injection. Drew and Schumann (1986) studied the homogeneity of potassium chloride in small volume intravenous containers and found there was no difference in the solutions whether mixed or not mixed.

Techniques utilized in nursing practice have been investigated. There have been several studies on therapeutic touch. Clark and Clark (1984) reviewed the literature and found that empirical support for the practice of therapeutic touch is at best, weak and suggested that current practice is empirically little more than practice at the placebo level. However, Keller and Bzdek (1986) investigated the effects of therapeutic touch on tension headache pain, and found that therapeutic touch may have potential beyond the placebo effect in the treatment of tension headache pain. Barsevich and Llewellyn (1982) did a comparison of the anxiety-reducing potential of two techniques of bathing; towel bathing and the conventional bed bath and discovered that both techniques reduced anxiety. A study of the effects of different lifting techniques as conducted by Gedan (1982), namely, mechanical lift, rocking axillary self lift, shoulder assist and straight pull, and it was found that the mechanical lift was the most taxing on the person being lifted. The effect of the birth chair on the duration of the second stage of labor, fetal outcome, and maternal blood loss was examined by Shannahan and Hansen (1985). The findings suggest that the birth chair does not present an advantage in terms of a shorter second stage of labor, and further study was recommended to rule out greater maternal blood loss with the birth chair.

Routine nursing procedures such as tracheostomy care have been studied. Harris and Hyman (1983) explored the relationship between clean versus sterile tracheostomy care in a study of post-operative pulmonary infection rates and laboratory data supported practicing clean procedures. Walsh et al (1987) evaluated the effect of controlled supplemental oxygenation without bag ventilation on transcutaneous partial pressure of oxygen measurements during tracheobronchial hygiene and discovered that in most patients, controlled supplemental oxygenation without bag was sufficient to prevent hypoxia during tracheobronchial hygiene. A pilot study was conducted to describe the frequency with which spontaneous tube displacement and risk factors occurred in 105 tube fed patients. Two risk factors, coughing and decreased level of consciousness, were found to occur with greater frequency in patients with displaced weighted nasogastric tubes while coughing, tracheal suctioning and upper airway intubation were significant in the dislodging of unweighted nasogastric tubes.

Williamson (1982) conducted a study to determine the effect of reconditioning upon bladder dysfunction caused by prolonged catheterization; it was found that there was no difference between the group which received reconditioning and the group which did not. However, small sample sizes were used in that study. A study by Parsons and Wilson (1984) examined the effects of six body position changes performed as part of routine nursing care intervention of 18 severely head-injured patients, and found that passive position changes may be performed safely upon severe closed head injured patients with baseline mean intracranial pressure (MICP's, $\leq$ 15 mm/Hg), provided that cerebral perfusion pressure (CPP's) is maintained above 50 mm/Hg throughout each position change. Nichols et al (1983) assigned 130 patients to three treatment groups to test the relationship between the frequency of changing intravenous tubing and the incidence of phlebitis, and it was concluded that more frequent tubing changes are not harmful to subjects and in fact could be beneficial. The foregoing studies are included as examples of the many clinical nursing investigations testing patient outcomes and nursing performance. The information generated could be easily incorporated into procedure and policy manuals if appropriate. This would then facilitate the dissemination and utilization of new information useful in clinical setting.

Research on Capillary Glucose Monitoring

The specific nursing procedure which is addressed in this study is capillary blood glucose monitoring which involves the use of the glucose oxidase strip. The glucose oxidase strips were introduced in the 1960's; however, they were not widely used until the middle 1970's. Reasons identified in the literature for the development of this method of capillary glucose testing were limitation of urine testing methods, inconvenience for patients who required frequent laboratory blood glucose testing, portability and convenience and the importance of normalization of serum glucose in the prevention of complications of diabetes (Chiasson et al , 1984; Skyler et al, 1980; Irsigler et al, 1980). Consequently, it appears that the original intent of the use of glucose oxidase strips was to facilitate home monitoring of blood glucose; it seems that they were intended for use only by diabetic patients themselves.

The products presently available to measure capillary blood glucose are many and varied. However, all utilize the same principle which consists of a reagent strip impregnated with glucose oxidase coupled to a chromosome which develops a color reaction to the glucose in the capillary blood sample. The results can be interpreted visually or with a reflection meter which is frequently calibrated to maintain reliability (Hernandez, 1983; White-Surr, 1983; Orzeck, 1982; McNeil, 1983). The most common of these strips are the dextrostix and chemstrip; the corresponding meters are the dextrometer and accu-chek.

With the recognition of the vital importance of the normalization or blood glucose in the prevention of complications of diabetes, the use of these glucose oxidase strips has become widespread (Irsigler et al, 1980; Cahill, et al 1977; Jovanovic and Peterson, 1980; Barr et al, 1984). Outpatient clinics and inpatient hospital settings are increasingly utilizing these methods of glucose monitoring and in the majority of cases they are being performed by staff nurses at the bedside (Schiffren et al, 1983; Aziz et al, 1983; Orzeck, 1982). Reasons identified in the literature for the increasing use of these strips are instant results thereby eliminating long waits for laboratory values, lack of paperwork and perceived reliability of these methods by medical and nursing staff (Forrest, 1979; Drucker et al, 1983).

Numerous studies have appeared in the literature which have tested the accuracy of the glucose oxidase strip and their instruments in the measurement of capillary blood glucose. These studies have been conducted by physicians, nurses, laboratory personnel and manufacturing companies. Virtually all the capillary glucose monitoring systems tested have been remarkably accurate when adequate education and frequent usage are factors in the situation in which the procedure is performed. These studies have been carried out on specialized nurses, physicians, laboratory technicians patients and to a lesser degree bedside nurses. Specialized nurses and laboratory workers show consistently high correlation coefficients of .92 to .98 as compared to reference laboratory values (Drucker et al 1983; Chiasson et al, 1984; Shapiro, 1981). Studies done to determine patients' performance of the glucose oxidase procedure have shown varied results with the correlation coefficients of .48 to .88 (Aziz and Hsiang, 1983; Fairclough et al 1983; Reed et al, 1986; Sonksen et al 1980). Nevertheless, numerous studies have shown that well educated patients obtain results which are as satisfactory as those of professionals (Ikeda et al 1978; Walford et al 1978). As well, patient studies reveal that the colormeter methods are more accurate than the visual method (Aziz and Hsiang, 1983; Frindik et al 1983) and patients, who experience eyesight difficulty, score higher with the use of the colormeters (Lombrail et al 1984; Aziz and Hsiang, 1983). Wing et al (1986) observed 62 children and adolescents while performing self-monitoring of blood glucose (SMBG) to determine which of the behaviors involved in SMBG were most likely to be performed incorrectly and which errors had the greatest effect on the accuracy of SMBG readings. Behaviours related to cleanliness and timing were performed most poorly; only 60% of the subjects correctly timed the first minute and 30-33% correctly timed the second interval. The behaviour that had the greatest effect on the accuracy of the SMBG reading was that concerning whether the blood was adequately wiped from the Chemstrip BG. Therefore, it was concluded that this behaviour should receive more emphasis in SMBG training programs.

There have been several studies carried out to determine bedside nurses' reliability in the use of these methods, some of which show disturbing results. In a well documented study by Drucker et al (1983), a comparative analysis was done to determine reliability of performance of the dextrostix/glucometer procedure by laboratory workers, bedside nurses, and a general practitioner. The findings showed that laboratory workers were accurate in 95% of the cases within ± 2 standard deviations of the mean reference laboratory value, whereas nurses achieved this level of performance in only 35% of the cases; in only 20% of the cases were general practitioners within this acceptable range. Even more alarming, the study indicated that nurses in 56% of the cases, and general practitioners in 40% of the cases, were outside of the ± 5 standard deviations of the mean reference value. However, laboratory workers were never outside this range. A further study by Smith (1983) corroborated this finding with 72 out of 128 staff nurses demonstrated a coefficient of variation of greater than 10%, whereas only 2 out of 126 laboratory technicians were outside this range.

In a nursing study by Hilton (1982), the technique was observed while registered nurses performed the visual chemstrip procedure. Five critical elements were defined as being vital for reliable performance of the chemstrip; the findings initiated that only 20 of 75 registered nurses performed the procedure with 100% compliance with the necessary elements. A limitation of this particular study was that there was no laboratory reference value done to determine the actual reliability coefficient of the chemstrip recordings.

A project by Almond (1986) examined capillary blood glucose monitoring and set out to discover whether nurses achieved results within acceptable limits for clinical practice determined to be within 20% of the reading obtained by the pathology laboratory. The findings from the study indicated that over 50% of the results were outside this limit. The study also showed that 60% of the nurses did not carry out the procedure accurately as measured by 100% compliance with four critical elements. The most common faults were failure to cover the test pad and poor technique for washing the blood off the strip. It was also found that generally nurses were unaware of the importance or significance of the procedure they were performing. It was thus concluded that education was necessary to improve accuracy (Almond, 1986).

In order to determine the accuracy of capillary glucose measurement by staff nurses, Godine et al (1986) initiated a program for instructing general staff nurses on the use of chemstrips bG strips and Accu-Chek bG meter. As a pilot study, nurses on four general medical and surgical hospital floor performed capillary glucose determinations within 15 minutes of the drawing of venous blood samples for determination of plasma glucose in the chemistry laboratory. Two hundred and ten paired measurements were made by 31 nurses. A Pearson correlation coefficient of .96 between bedside and laboratory glucose measurements was obtained. Therefore it was concluded that properly supervised capillary glucose monitoring can provide a valuable adjunct to the care of the hospitalized patient with diabetes.

The Committee on Monitoring Devices of the Canadian Association of Pathologists has developed guidelines on the use of blood glucose meters and non metered blood glucose regent strips in hospitals. This was done in response to a cross sectional survey of Canadian hospitals which revealed a large diversity of practices in the use of blood glucose meters visual blood glucose reagent strips as well as personnel providing the service. The guidelines stress the importance of quality control of the equipment, supplies, and operator performance, and further recommends that the hospital laboratory be directly responsible for quality control, preventative maintenance and proficiency testing by the use of standards, controls and simultaneous determinations of the venous blood glucose level by the laboratory. In terms of quality assurance, the guidelines state that users must perform the procedure with reasonable frequency to maintain skill and reliability. As well, the service should be subject to periodic audit by authorized medical staff and administrative officers of the institution. Further, procedures to establish, implement and evaluate decentralized blood glucose measurements and to evaluate the performance of personnel should be included in the accreditation program of the Canadian Council of Hospital Accreditation (Committee on Monitoring Devices of the Canadian Association of Pathologists, 1988).

It is clear from the literature that in spite of the increasing use of glucose oxidase strips, there have been concerns about the monitoring of current and ongoing accuracy of these methods. This is disturbing as nursing staff have assumed the responsibility for a function which has been traditionally performed by the laboratory without ensuring the establishment of the quality control program which is integral in a laboratory setting. Several studies have documented adequate accuracy levels with the establishment and maintenance of an educational program (Williams et al 1984; Hilton, 1982; Joyce et al, 1983; Godine et al 1986). Other studies have demonstrated low accuracy levels without adequate educational programs (Drucker, 1983; Almond, 1986). It was the purpose of this study to determine the effects of a carefully designed educational program on the accuracy of the visual bG chemstrip procedure by staff nurses in a impatient hospital setting. Therefore the unique contribution of this study was to clearly establish the effect of an educational program on the accuracy of the visual chemstrip procedure. The information generated could be used by hospital personnel in the development of specific standards of patient care and nursing practice for the chemstrip procedure and incorporated into the quality assurance program. This would ensure ongoing compliance with the established standards. It is essential that the nursing and laboratory departments work collaboratively in order to establish effective and efficient procedures which will show acceptable levels of accuracy on an ongoing basis.

CHAPTER III

Methods and Procedures

Research Design

An experimental design was used, namely the post test only design (Campbell and Stanley, 1966). The purpose of the study was to explore the relationship between the administration of a certification program to nurses and the accuracy of their performance of the visual chemstrip procedure. As well, estimation of the accuracy of the chemstrip procedure under certain conditions was a study objective. The two conditions necessary for an experimental design, experimental manipulation and randomization were met. Experimental manipulation was achieved by the administration of the certification program to the experimental group and not to the control group. Randomization was met by randomly assigning participants to the control and experimental groups.

Study Samples

Nursing Group The total population of nurses who are employed on four 40-bed medical units was sent a letter requesting their participation in this study. One hundred and two letters were sent out (See Appendix D): Names of nurses were obtained from the position control computer sheets obtained from the unit supervisors of the four units involved. Included with the letter was a consent form for nurses' participation in the study (See Appendix B). Eighty-four nurses responded and consented to participate in the study. The 84 nurses or 82% of the target group were then randomly assigned to the experimental and control groups by the use of a random number table.

Patient Group The target population for this group consisted of all patients who were admitted to the four medical units and who had an SMA-6 or blood glucose test ordered by their physician during the time frame for the data collection. An explanation of the research project was given to each patient and written consent obtained for the chemstrip to be performed within one minute of the laboratory test (See Appendix C).

Setting

Four 40 bed medical units of a 550 teaching acute care hospital were used as the setting for this study. The medical service was the area of the hospital where most of the chemstrips were done because of the treatment and diagnostic nature of the patient population. Therefore, the nurses on these units were thought to be the most competent in the performance of the chemstrip procedure.

Data Collection Procedure

All nurses participating in the study whether in the experimental or control group were given an identification number and sent a letter with explicit instructions for proceeding (See Appendix E & F). The nurses in the experimental group were instructed to begin with the data collection after they were certified for the chemstrip procedure. The protocol for the study stipulated that each nurse would do two chemstrip procedures on patients who had blood glucose or SMA-6 ordered. The patient's informed consent and signature was obtained by the nurse involved. As well, there was liaison with the laboratory staff. The procedure stipulated that the nurse contact the laboratory staff in advance to inform them that a concurrent chemstrip was to be done. The laboratory staff were requested to notify the nurse upon reaching the nursing unit. The chemstrip was then done within one minute of the blood being drawn by the laboratory staff. Data forms were also provided to all participating nurses (See Appendix G) and completed as directed. The data forms included patient demographic data as well as the nurse's identification number, date, time and chemstrip result. When completed, the data forms were placed in a container provided on each nursing unit. As well, the signed patient consent forms were kept in a labelled folder on each nursing unit. The nurses in the control group proceeded in the same fashion with the exception that they did not receive the certification program. This process was continued until 90% of the data was returned which took approximately three months. The principal investigator collected the data forms and signed patient consent forms twice a week. As well, the concurrent laboratory blood glucose values were obtained in conjunction with the laboratory staff and marked on the data form. The data were comprised of a series of chemstrip recordings performed by nurses from the experimental and control groups as well as the concurrent laboratory blood glucose recordings. At the conclusion of the data collection process, a total of thirty-six nurses from the experimental group had participated in the study and performed one to two chemstrips each to a total of seventy chemstrip recordings; the control group included thirty-four participants who had performed two chemstrips each to a total of sixty-eight chemstrip recordings. Six pieces of data had to be discarded for various reasons such as incorrect timing and missing information.

An analysis of the existing level of accuracy of the staff nurses performance of the visual chemstrip procedure was carried out by assessing the relationship of the chemstrip value of the nurses in the control group with the corresponding laboratory value. The next step in the data analysis process was to determine the effects of a certification program for nurses on the accuracy of the nurses' performance of the visual chemstrip procedure. This was achieved by assessing difference between the data from the experimental group and data from the control group. Finally, the experimental group data were further subdivided to determine the effects of the time interval between the certification data and the chemstrip test date on the accuracy of the chemstrip recording.

The existing level of accuracy of nurses' performance of the visual chemstrip procedure on four medical units of the study hospital was determined by the assessment and analysis of the control group data. Each of the thirty-four nurses from the control group who participated in the study, performed two chemstrips on patients within one minute of a laboratory blood glucose being drawn by the laboratory staff. The data from the control group were organized into two measurements; the first being Nurse I and Chemstrip Recording I; the second being Nurse I and Chemstrip Recording II. The concurrent laboratory blood glucose was included for all chemstrip recordings. Each of the two measurements in the control group included thirty-four chemstrip recordings and thirty-four laboratory blood glucose recordings.

As noted in Chapter I, performance of the chemstrip procedure by nurses began in 1983 at the study hospital. Nurses were performing 400-450 procedures per week on the four nursing units at the time of data collection. An education program was administered to most of the nurses when the procedure was initially introduced. Following that, brief inservice sessions on the procedure occurred. As well, new employees received an educational program to teach them how to perform the chemstrip procedure as part of their orientation program. However, it was evident that the existing educational programs did not generate the depth or consistency of the certification program which was developed and administered to the nurses in the experimental group. Therefore, although the thirty-four nurses in the control group had received some education about the procedure, the education provided was inconsistent in terms of breadth, depth and currency. For example, there was no evaluative component built into the program such as pre and post tests, or demonstration and return demonstration of the chemstrip technique. As well, the brief inservice sessions of the procedure did not include a demonstration, return demonstration or evaluative component.

Since subjects for the control group were randomly selected, the educational factors identified in the previous paragraph would, in all likelihood, be randomly distributed throughout this group. Therefore, analysis of results would yield an indication of the status quo in terms of the nurses performance of the chemstrip procedure on the four medical units involved in the study.

The data from the experimental group were analyzed and subsequently compared to that from the control group to determine the effects of a certification program for nurses on the accuracy of their performance of the chemstrip procedure. At the outset of the study, there were forty-two nurses randomly assigned to the experimental group, to whom a certification program for the chemstrip procedure was administered. This program consisted of an in depth theoretical component as well as a skill testing component which included a practical demonstration by the instructor and return demonstration by the participant. An evaluative component was also part of the certification program (See Appendix A). The certification program was administered to small groups of nurses from one to a maximum of four nurses at one time. The instructors were two nurse clinicians whose qualifications included a baccalaureate degree in nursing as well as several years of clinical nursing education. Further, the two instructors normal tour of duty included the teaching and orientation of staff nurses. The certification program consisting of approximately two hours of pre-reading as well as a lecture component, demonstration, return demonstration, and post test was completed over an approximate one hour time frame per individual session. The certification program was administered to all the nurses in the experimental group over a four week time frame. As soon as the certification process was completed for an individual, the nurse was instructed to proceed with the performance of two chemstrip recordings on patients who had consented to participate in the study and within one minute of the drawing of blood for the laboratory blood glucose test being conducted by laboratory staff.

At the end of the data collection period, thirty-six nurses from the experimental group had participated in the study. Thirty-four had performed two chemstrips each and two had completed one chemstrip each. The analysis of the experimental group then, provided an indication of the effect of the certification program on the accuracy of performance of the chemstrip procedure. The only known difference between the experimental and control group was to be found in their exposure to the certification program. Therefore, if there were differences between the two groups, it is likely that these could be attributed to the intervention. This data were also organized into two measures; the first being Nurse I and Chemstrip Recording I to a total of thirty-six chemstrip recordings and Nurse I and Chemstrip Recording II for a total of thirty-four recordings. Moreover, the concurrent laboratory blood glucose value was included for each individual chemstrip recording.

Reliability and Validity

The threat to internal validity posed by history and maturation was reduced by the randomization process. History refers to events in addition to the intervention or the certification program which may affect the outcome. With random assignment to experimental and control groups, it can be assumed that external factors would be as likely to affect one group as the other. The only probable difference then between the control and the experimental was in the exposure to the intervention. Therefore, if there are differences between groups, the likelihood of the differences being due to the intervention is high. Maturational effects or changes that occur over time would affect both groups similarly as well. However, since the data were collected over a fairly short time frame, effects from maturation should be minimal. Further, there was some question in relation to the effects of the time interval between the certification date and the test date for the experimental group. A decision was made to investigate this factor in the data analysis.

The possible threat to internal validity from differences in outcome that could be attributed to experimental mortality was not a factor. Although there were four subject withdrawals due to resignation and transfer, it was not considered a significant factor. The response from patients was excellent and participation rate in the study was high. There were 110 patients who consented to participate, some of them more than once. There were only two patients who refused to participate.

The accuracy and precision of the laboratory glucose test value was assumed because of the well established quality control program operating in the laboratory. The laboratory at the study hospital participates in an interlaboratory program (Western United States and Canada) to ensure the accuracy and precision of blood analyses. A correlation co-efficient of .95 is maintained by this quality control method. The accuracy of the glucose oxidase strip was ensured by supplying chemstrips to the nursing units which were not outdated and which had not been inadvertently exposed to sunlight. The investigator made checks twice a week of the chemstrip containers to ensure the cap was tightly on and that the chemstrips were not outdated. On no occasion was any problem found with the containers.

In terms of external validity or the degree to which the findings can be generalized to other populations, one hopes to generalize the findings to nurses in similar settings who might be asked to perform this procedure. The medical units were chosen for the study because of their relatively homogeneity as far as the regular performance of a high number of chemstrips, and the amount and type of instruction which had been given to the nurses. It was decided at the outset that nurses who had previously been certified for the chemstrip study would not be included in this study; however, this was not a factor as none of the nurses in the target population had ever been certified for this procedure. A factor which may influence generalizability is the number of chemstrips performed by each nurse within a certain time period per nursing unit. Because of the nature of the patient population in certain clinical settings, some nurses are rarely required to perform the chemstrip procedure; the generalization of findings to these situations would seem to be inappropriate.

Data Analysis

The statistical techniques known as simple regression analysis and Student's t test were utilized to analyze the data in keeping with previously outlined study objectives. The relationship between the laboratory and chemstrip values for both experimental and control groups was expressed in terms of R^2. Results for the experiment and control group were then compared on the basis of a one tailed t test. The t-test for independent samples was utilized for this particular analysis.

Further, an analysis was undertaken to assess the effect of the time interval between the certification program and the test date relative to the accuracy of the chemstrip recordings. An arbitrary cut-off date of three weeks was established; the experimental group was subdivided into those chemstrip recordings which were done within the three week timeframe of the certification date and those performed outside of the three week timeframe. The relationship between chemstrip recordings and laboratory results, was again expressed in terms of R^2 and the differences between groups compared on the basis of a one tailed t test.

Chapter IV

Results and Discussion

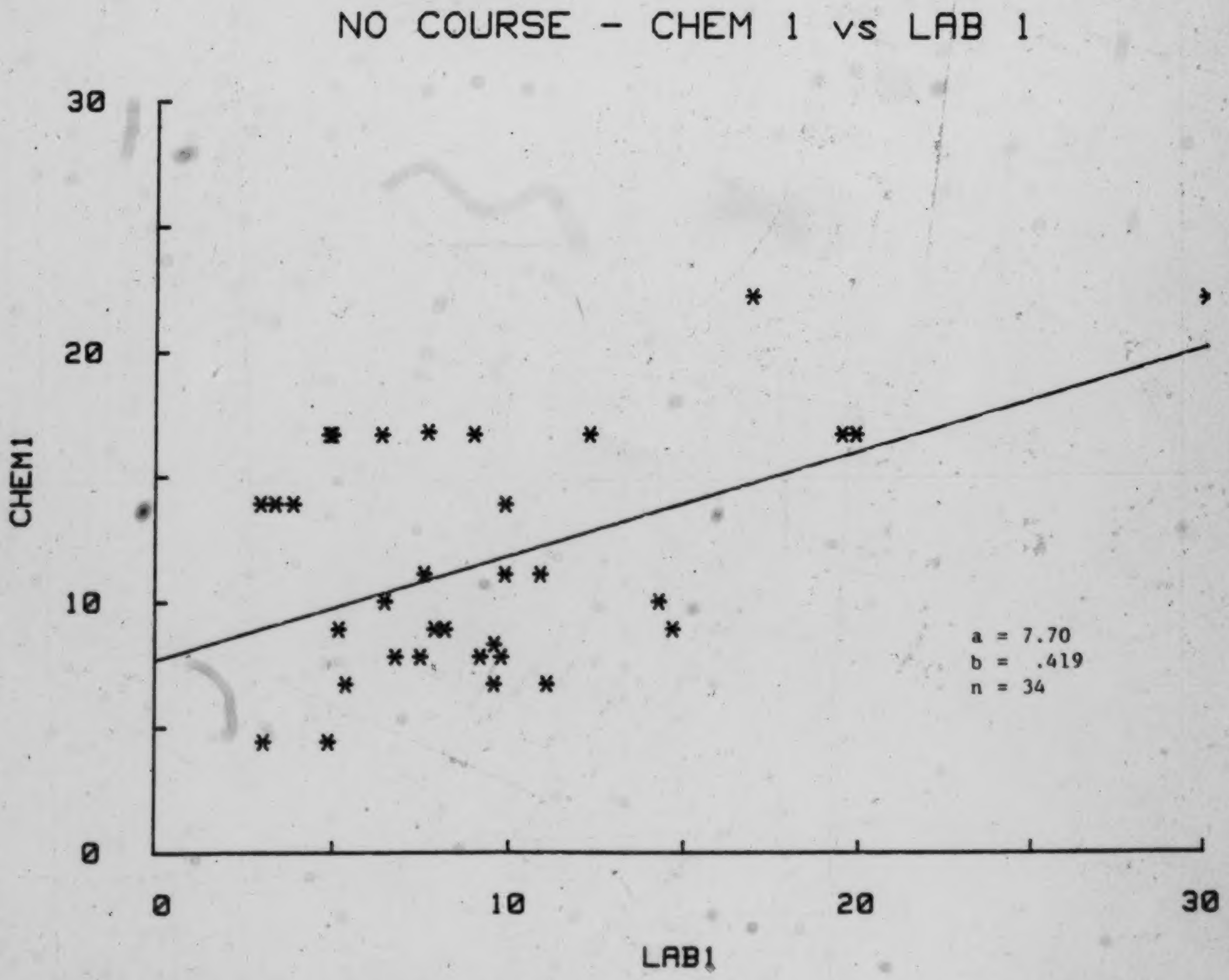
In this chapter, the results of the study are analyzed and discussed in the light of the research objectives outlined in Chapter I. The relationship between the chemstrip recording and the laboratory value was determined by simple regression analysis and the differences between groups was assessed on the basis on a one tailed t test for independent samples.

Control Group Data

There are two measures of control group data; Nurse I/Chem I and Lab I and Nurse I/Chem II and Lab II. For both measures the percentage difference between chemstrip recordings and laboratory blood glucose recordings was calculated for each individual recording. The data from Nurse I/ChemI/Lab I contained a range of percentage difference values from 1.83 to 363.33 with the mean percentage difference being 71.53. Regression analysis for measure Nurse I/Chem I/Lab I with n = 34 yielded a = 7.70 and b = .419 (See Fig. 1). The intercept (a) is the point at which the line crosses the y axis which in this case is 7.70. The slope (b) is the angle of the line relative to the X and Y axis which in this case is .419. The square of r (R^2) indicates the proportion of the variance in Y that can be accounted for in X. In this group, r = .419 so R^2 is .175. This indicates that 18 percent of the variability in

FIGURE I

CONTROL SUBGROUP NURSE I/CHEM I/LAB I



Chemstrip recordings of 34 "uncertified" nurses paired with concurrent laboratory glucose value

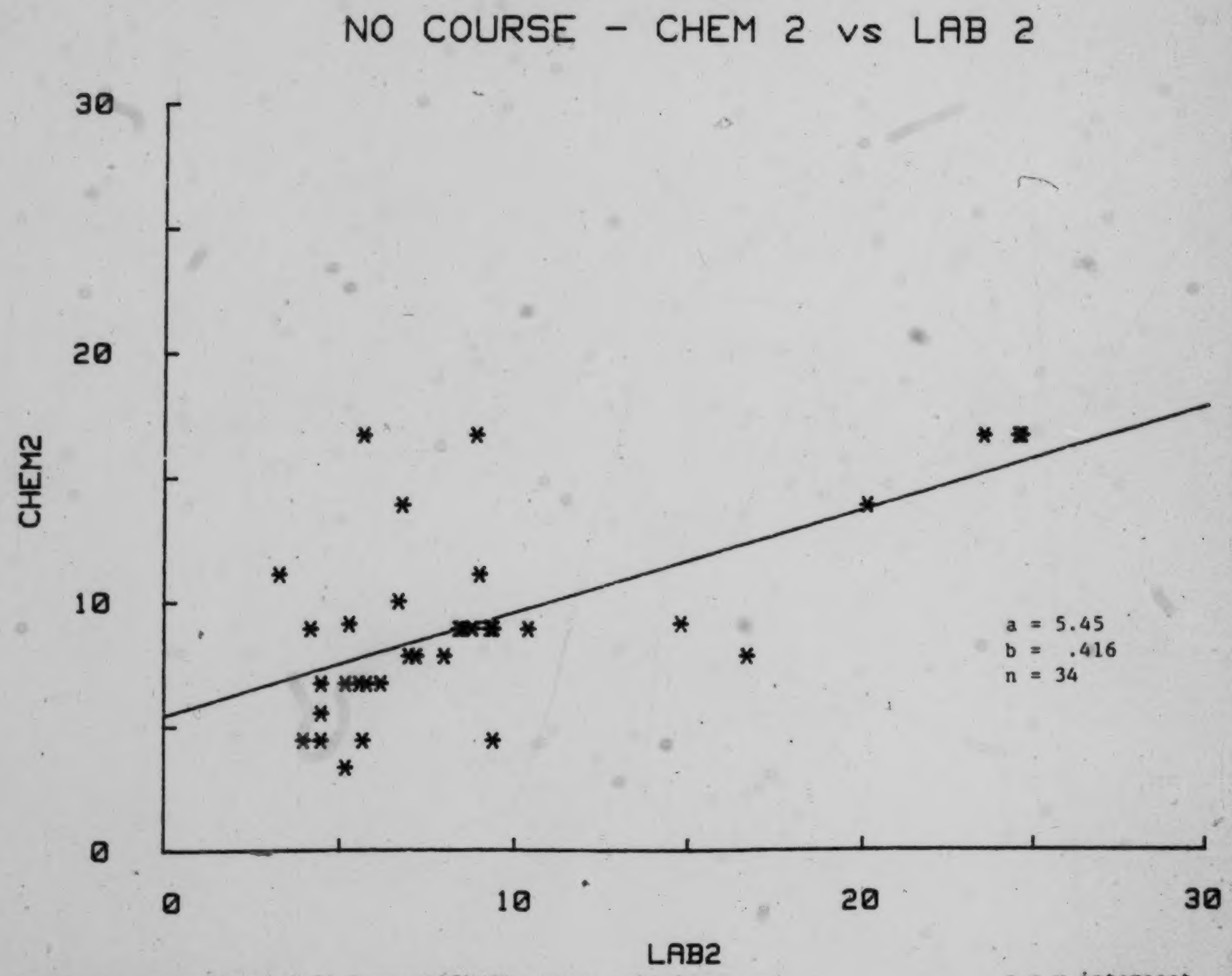
a = y intersect
b = slope
n = number of observations

the chemstrip recording can be understood in terms of the variability in the laboratory value. The remaining 82 percent is unrelated to individual difference in the laboratory value and constitutes variability from some other source of influence. The data from Nurse I Chem II Lab II contained a range of percentage differences from 1.14 to 236.36 with the mean percentage difference being 41.75. Simple regression analysis with n = 34 yielded a = 5.45 and b = .416 (See Fig. II). This means that for this measure 17 percent of the variability in the chemstrip value can be understood in terms of the variability of the laboratory value and the remaining 83 percent constitutes variability from some other source.

Regression analysis was done on both measures of the control group data and with n = 68 yielded a = 6.54 and b = .421 (See Fig. III). Therefore for the total measure of the control group data only 18 percent of the variability in the chemstrip recording can be understood in terms of the variability of the laboratory measure. The remaining 82 percent constitutes variability from some other source. Consequently, the control group data indicate a lack of relationship between the laboratory measure and chemstrip recording. In practical terms for both these measures the use of the chemstrip value to predict the laboratory value is highly inappropriate as the chemstrip value measures very little relative to the laboratory value.

FIGURE II

CONTROL SUBGROUP NURSE I CHEM II LAB II

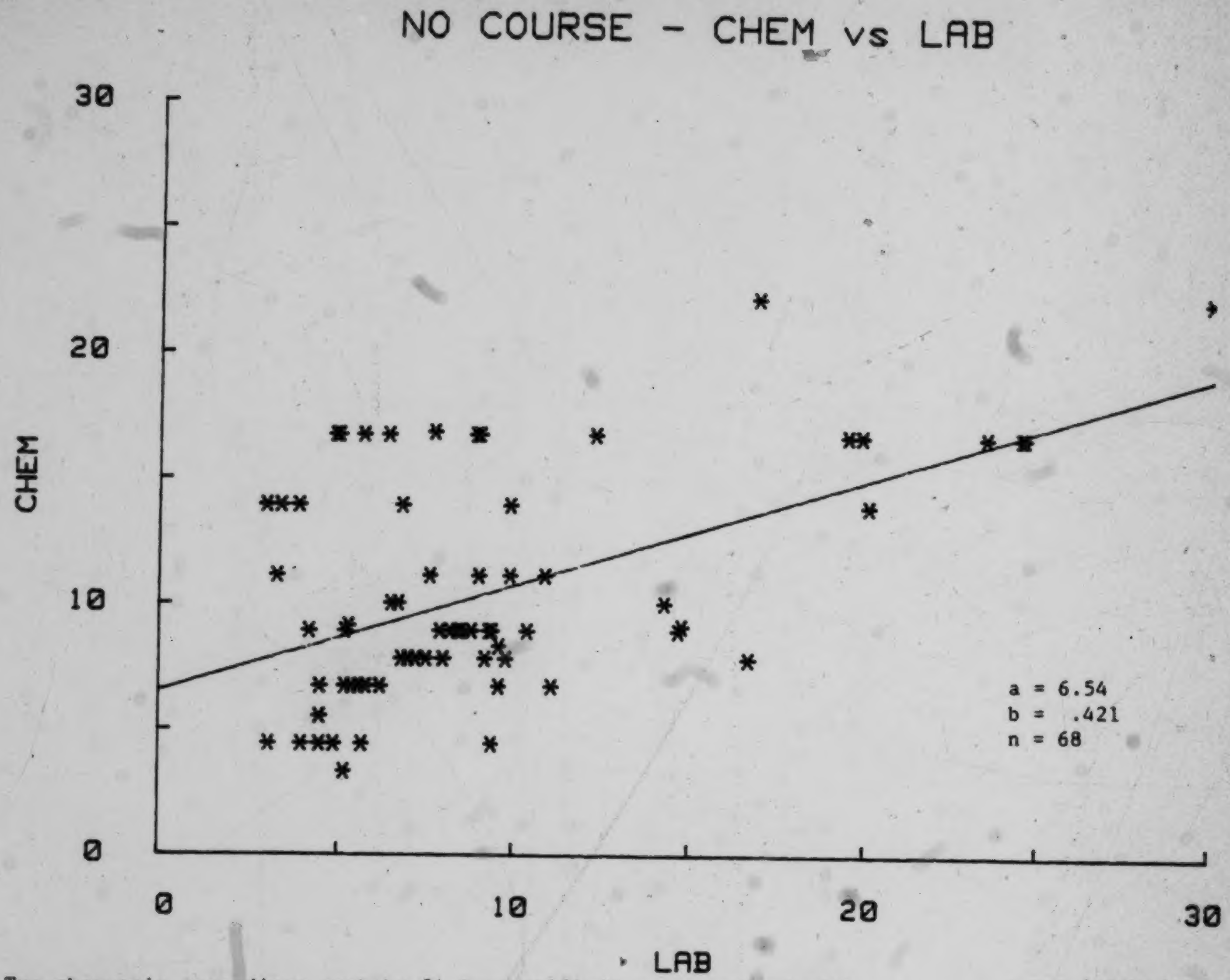


Chemstrip recordings of 34 "uncertified" nurses paired with concurrent laboratory blood glucose value

a = y intersect
b = slope
n = number of observations

FIGURE III

CONTROL SUBGROUPS NURSE I/CHEM I/LAB I AND
NURSE I/CHEM II/ LAB II COMBINED



Two chemstrip recordings each by 34 "uncertified" nurses paired with concurrent laboratory blood glucose value.

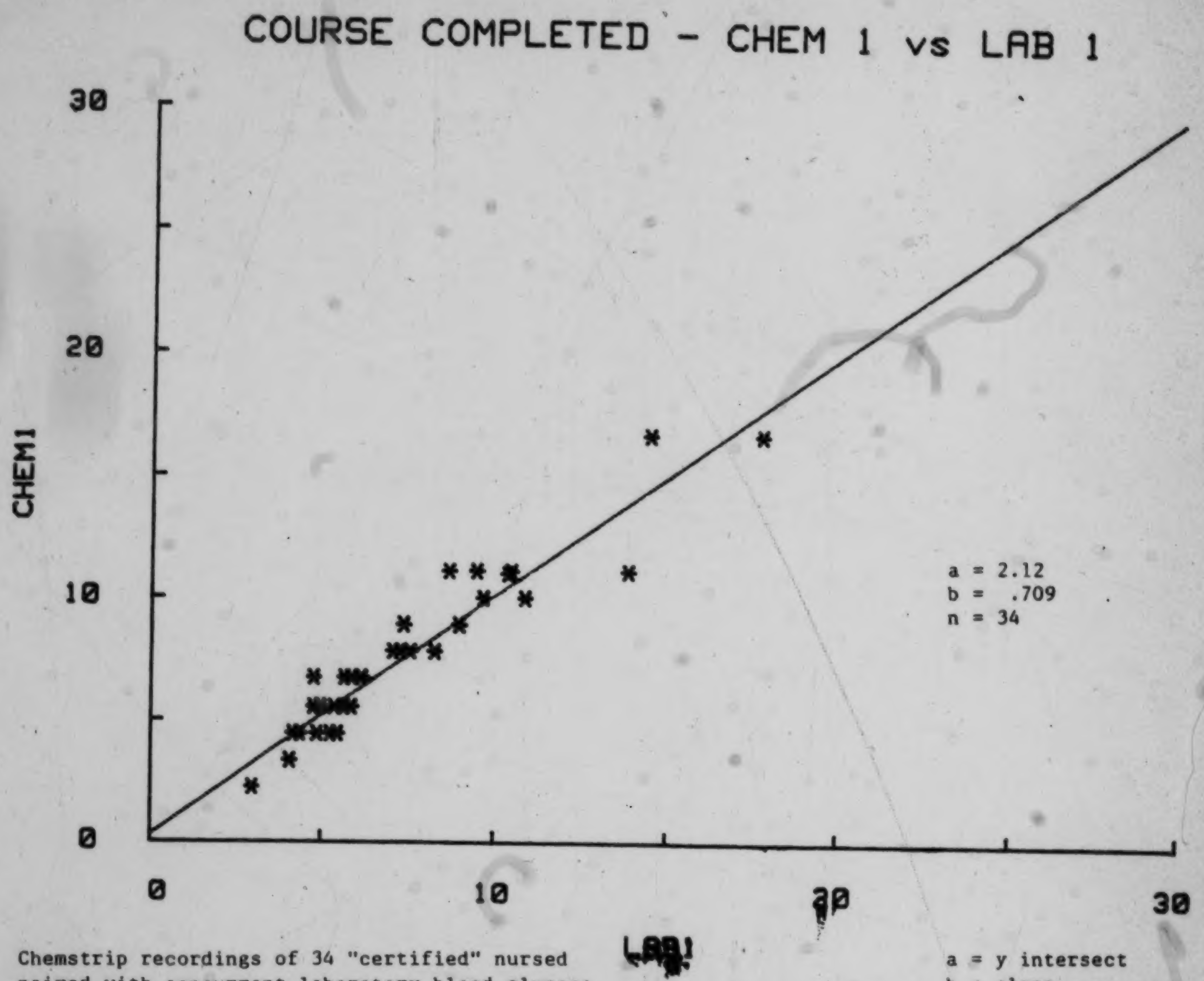
a = y intersect
b = slope
n = number of observations

Experimental Group Data

There are also two measures of experimental group data Nurse I Chem I/Lab I/ and Nurse I/Chem II/Lab II similarly, as for the control group the percentage difference between chemstrip recording and laboratory recordings was calculated for each individual recording. The data from Experimental Nurse I Chem I Lab I contained - 34 recordings and a range of percentage differences from 00.00 to 39.58 with a mean of 11.44. Simple regression analysis yielded a = 2.12 and b = .709 (See Fig. IV). Therefore, 50% of the variability in the chemstrip recording can be understood in terms of the variability in the laboratory value. The remaining 50% is unrelated to individual differences in the laboratory value and constitutes variability from some other source of influence. Further, the data from Experimental Nurse I Chem II Lab II which contained 36 recording revealed a range of percentage differences from 0.00 to 42.80 with a mean percentage difference of 8.11. Regression analysis yielded a = .292 and b = .982 (See Fig. V). In view of these results 96% of the variance in the chemstrip value in this measure is related to individual differences in the laboratory value. Therefore, the remaining 4 percent constitutes variability from some other source. The two measures analyzed together yielded n = 70, a = 1.54 and b = .793 (See Fig. VI). Therefore for the total measure of the experimental group 63 percent of the variability in the

FIGURE IV

EXPERIMENTAL SUBGROUP NURSE I/CHEM I/LAB I

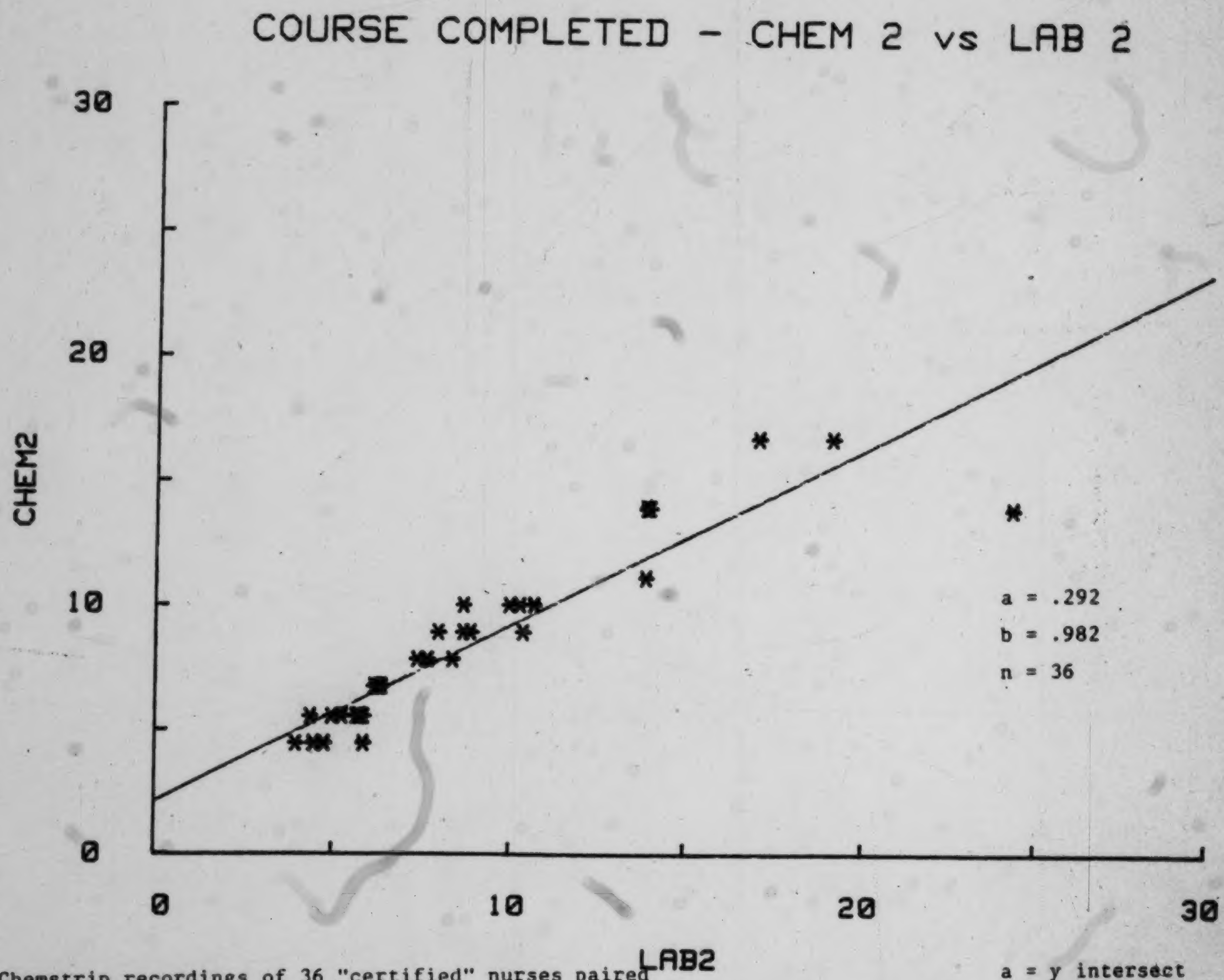


Chemstrip recordings of 34 "certified" nursed paired with concurrent laboratory blood glucose value

a = y intersect
b = slope
n = number of observations

FIGURE V

EXPERIMENTAL SUBGROUP NURSE I/CHEM II/LAB II



Chemstrip recordings of 36 "certified" nurses paired with concurrent laboratory blood glucose value

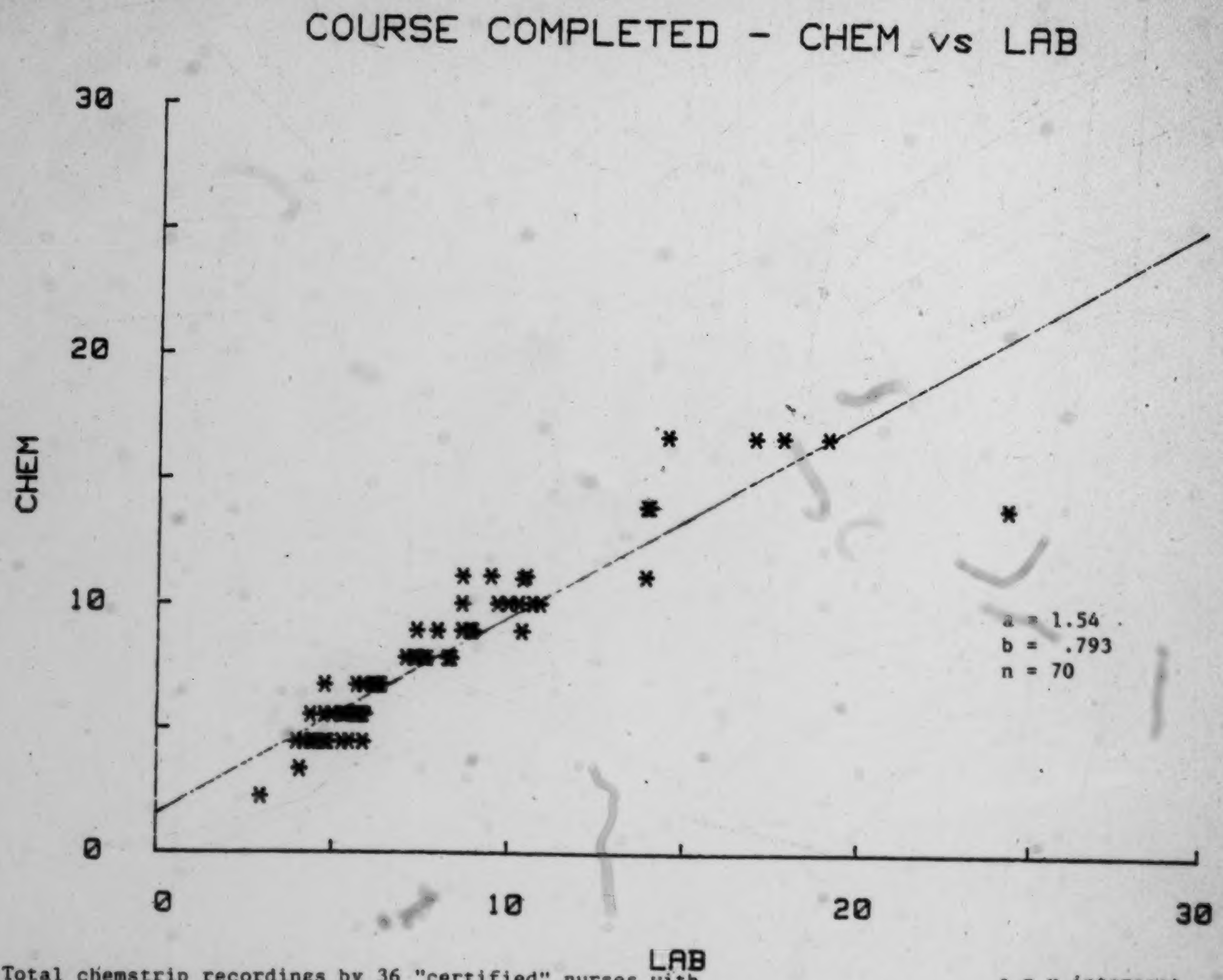
a = y intersect

b = slope

n = number of observations

FIGURE VI

EXPERIMENTAL SUBGROUPS NURSE I/CHEM I/LAB I
AND NURSE I/CHEM II/LAB II COMBINED



Total chemstrip recordings by 36 "certified" nurses with concurrent blood glucose value

a = y intersect
b = slope
n = number of observations.

chemstrip can be understood in terms of the variability of the laboratory measure and 37 percent is unrelated to individual differences in the laboratory value. On a practical level the analysis of the experimental group indicates a significant degree of relationship between the laboratory measure and the chemstrip value.

Comparison of Experimental and Control Group

The analysis to establish the differences between the experimental and control group was carried out using an independent Student t test. The following computations were carried out as a basis for the analysis: (1) the percentage difference between chemstrip value and concurrent laboratory value for each measure of both experimental and control groups and (2) the mean percentage difference of both measures within the experimental and control group. The null hypothesis in this case assumed there would be no difference in accuracy levels between experimental and control groups. The substantive hypothesis states that: staff nurses who have successfully completed a certification program (experimental group) will show more accurate chemstrip results than those staff nurses who have not received the certification program (control group) was tested by this comparison of the experimental and control group. The level of significance was specified at .01. Thus there is only one chance in one hundred that a particular result could have occurred by chance alone. A one tailed t test was used to analyze the data. The observed value of the statistic was calculated to be 5.16. This was far beyond the critical value of 3.35 for a one-tailed probability of .01 (See Table I). Therefore, the hypothesis for the study was clearly supported. It was evident that the percentage difference between the chemstrip value and the laboratory value for the experimental group was significantly less than the percentage difference between chemstrip value and laboratory value for the control group. This suggests that the experimental group was more accurate than the control group in performing chemstrip recordings as measured by comparability to the laboratory measures. Consequently, since the groups were randomly assigned and since the only known difference between the groups was their exposure to the intervention (the administration of the certification program), the difference between the groups was attributed to this intervention. The vital importance of a proper educational program which includes both theory and practice as well as an evaluative component was strongly supported by the results.

The experimental group was further subdivided into two groups according to the time difference between the certification date and the chemstrip test date. One group included those who had chemstrip recordings performed within three weeks of the certification program (Chem I/Cert I); the other group included those recordings which were

TABLE I

RELATIONSHIP BETWEEN EXPERIMENTAL AND CONTROL GROUPS

Variable	Number of cases		Mean	Separate t Value	Degrees of Freedom	One Tail Significance
**PD1	% Diff.	Value		3.64	68	*
	Group 1	36	11.44			
	Group 2	34	71.53			
PD2	% Diff.	Value		3.68	66	*
	Group 1	34	8.11			
	Group 2	34	41.74			
PDA	Mean of PD1 & PD2			5.16	68	*
	Group 1	36	9.87			
	Group 2	34	56.63			

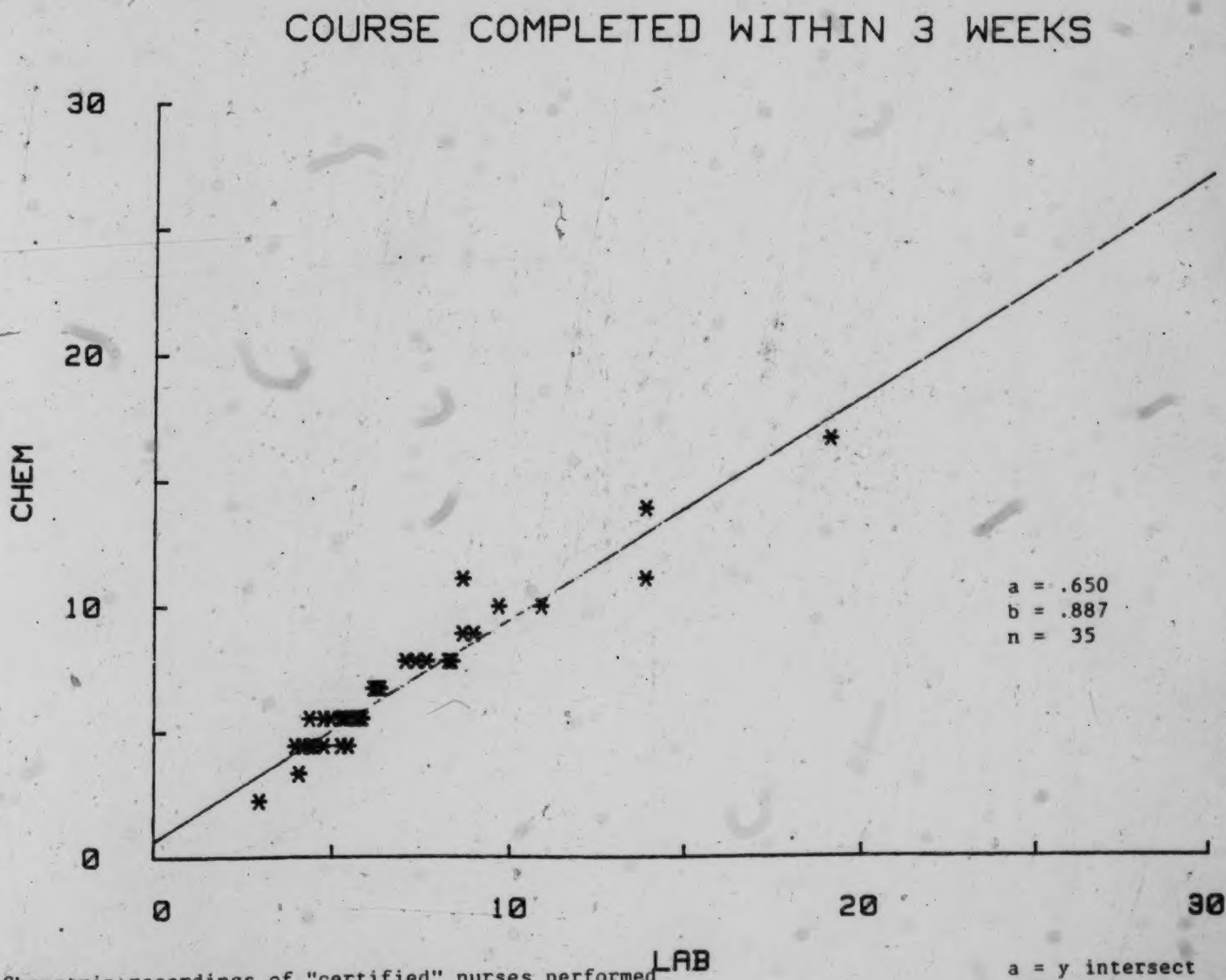
**Percentage Difference

*Significant at = 0.01 level

performed at a point in time outside of three weeks following the certification program (Chem I/Cert II). The total number of recordings in the experimental group was seventy; thirty-five were done within the three week timeframe, and thirty-three were outside the three week cutoff date. Two groups were then compared to determine differences in the accuracy of performance of the nurses. The subgroup Chem I/Cert I yielded regression analysis of a = .650 and b = .887 with n = 35 (See Fig. VII). This indicates that 79 percent of the variability of the chemstrip value can be understood in terms of the variability in the laboratory measure. Therefore 21 percent is unrelated to individual differences in the laboratory value consequently, there is a significant degree of linear relationship between laboratory and chemstrip value of this subgroup. The subgroup Chem I/Cert II yielded regression analysis of a = 2.83 and b = .669 with n = 33 (See Fig. Viii). This indicated that 45 percent of the valuability of the chemstrip value can be understood in terms of the variability in the laboratory measure while 55 percent constitute variability from some other source. Therefore this subgroup reveals a significant degree of relationship between laboratory and chemstrip values. The one tailed t-test did not reveal a significant difference between groups (See Table III). In practical terms this finding indicates that there was no effect based on the early or late

FIGURE VII

EXPERIMENTAL SUBGROUP CHEM I/CERT I

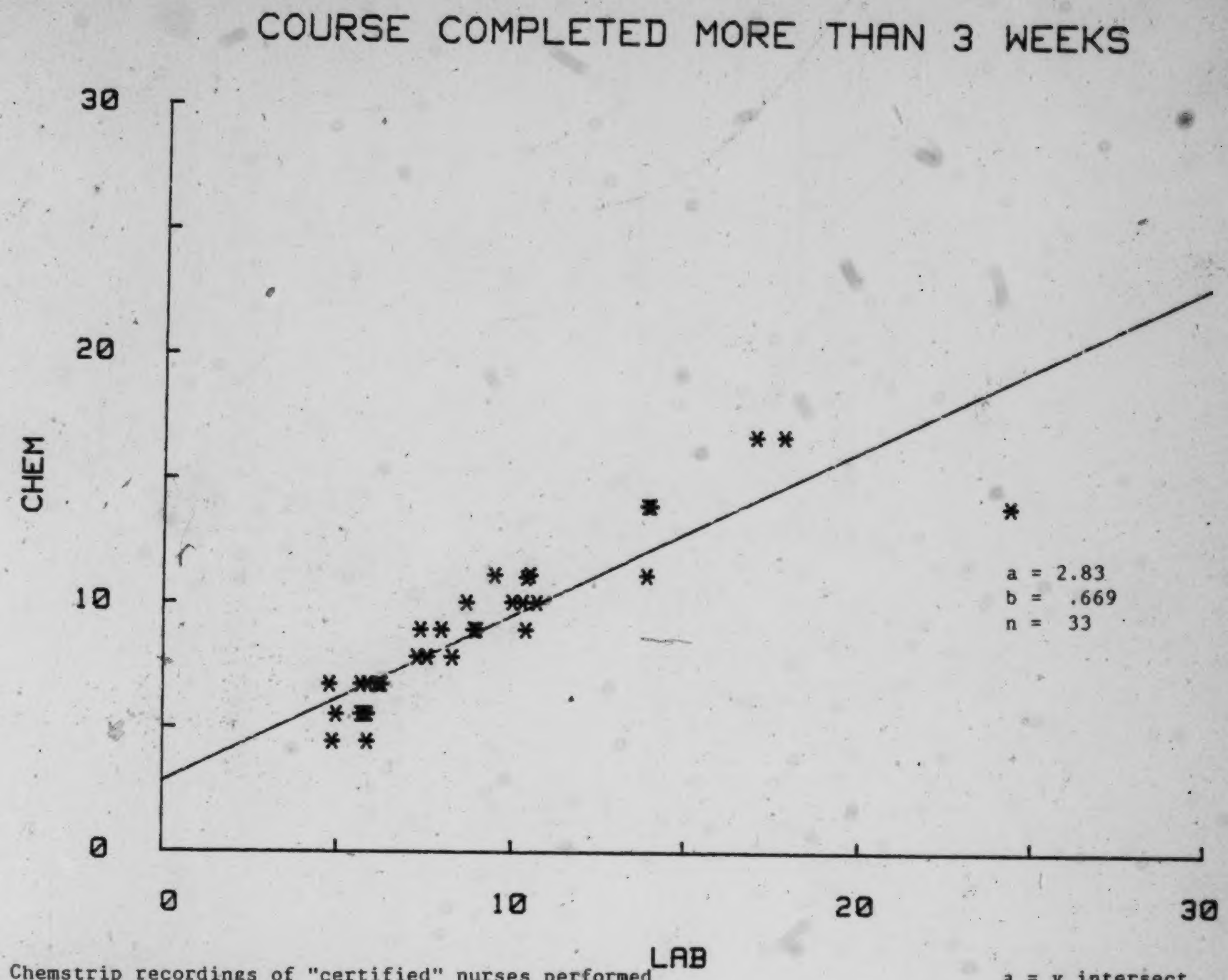


Chemstrip recordings of "certified" nurses performed within three weeks of certification date paired with concurrent laboratory blood glucose values

a = y intersect
b = slope
n = number of observations.

FIGURE VIII

EXPERIMENTAL SUBGROUP CHEM I/CERT II



Chemstrip recordings of "certified" nurses performed outside of three weeks of the certification date paired with concurrent laboratory blood glucose values.

a = y intersect
b = slope
n = number of observations.

TABLE II

RELATIONSHIP BETWEEN EXPERIMENTAL SUB-GROUPS RELATIVE TO DAYS BETWEEN CERTIFICATION AND TRIAL

Variable	Number of cases		Mean	Separate t Value	Degrees of Freedom	One Tail Significance
Chem	Chem Value Trial 1	35	7.08	2.27	34	N/S
	Trial 2	35	8.90			
Lab	Lab Value Trial 1	35	7.19	1.98	34	N/S
	Trial 2	35	9.07			
Diff	Diff Between Chem & Lab 0-3 Weeks	35	0.67	0.94	34	N/S
	3+ Weeks	35	0.97			

*Significant at = 0.01 level
N/S Not significant at =0.01 level

performance of the procedure following the certification program. However, this finding may be of limited value that it evaluated a relatively short span of time (0-6 weeks). Further followup in several months to assess accuracy levels could produce interesting results.

Summary

The data analysis confirmed to a large degree that the concerns and questions relative to the ongoing accuracy of the nurses performance of the chemstrip procedure were indeed very valid. The control group data revealed that there was a unsatisfactory relationship between the chemstrip value performed by the nurse and the blood glucose value performed by the laboratory staff. Given that the laboratory blood glucose value maintains a Pearson's r of .95, it is assumed to be the accurate value. Thus, the chemstrip values obtained by the nurses in the control group disclosed significant margin of error as compared to the laboratory value. This finding was significant in that it indicated that for this group of nurses, one could not confidently predict the laboratory blood glucose based on the chemstrip recording performed by the nurse. Therefore, clinical decisions such as the ordering of insulin based on the chemstrip value, would be clearly inappropriate given these findings. Conversely, the analysis of the experimental group data revealed a strong linear relationship between the chemstrip recording by the nurse and the blood glucose recording by the laboratory. A high degree of accuracy in the nurse's performance of the chemstrip as measured by the tightness of fit to the laboratory blood glucose level was indicated. This is significant in that for the nurses in the experimental group one can predict with some confidence the laboratory blood glucose based on the result of the nurses performance of the chemstrip.

Moreover, the t-test analysis, used to compared the results of the experimental and control group in relation to the effect of the educational program on the accuracy of the chemstrip performance, revealed that the experimental group has significantly lower average percent difference from laboratory results indicating that nurses in th experimental group were much more accurate than the control group. It is likely the difference between the groups then can be attributed to the intervention of the certification program since the groups appear to differ only on this dimension. Thus the certification program consisting of a theoretical, practical, and evaluative component appeared to be sufficient to improve the accuracy level of the nurses' performance of the chemstrip procedure to an acceptable level.

Further analysis of the data involved subdividing the experimental group to include one group where chemstrip recordings were performed within a three week cutoff date from the certification program (Chem I/Cert I) and another sub-group with those chemstrip recordings later than this three week cutoff date (Chem I/Cert II). The two tailed t test did not reveal significant differences between the two groups. This finding indicated high accuracy levels of nurses' performance of the chemstrip procedure over the six week time frame appeared to result from the certification program. These results can only be considered to occur only as they relate to the time periods studied. It is noted that although the t test did not reveal a significant difference between the groups, the accuracy levels did decrease somewhat from sub-group Chem I/Cert I (within three weeks of certification date) to sub-group Chem I/Cert II (outside three weeks of certification program) (see Table III and Figure VII and VIII). Thus, future follow-up to determine if accuracy levels continue to decrease over time would seem to be warranted.

Because of the clinical significance of the results of the data analysis, the study hospital was contacted immediately and informed of the results. Since clinical decisions continued to be taken based on the chemstrip recordings and since some nurses throughout the study hospital were uncertified it was believed to be necessary to inform the necessary hospital personnel so that appropriate action could be taken to correct the deficiency. Possible actions which could be taken include an extension of the certification program to all nursing staff or a discontinuation of the chemstrip procedure by nursing staff in selected areas.

Furthermore, even if all nurses are certified or if there is selective performance of the chemstrip procedure by nursing staff, it is essential to ensure that accuracy levels remain acceptable on an ongoing basis. This can be achieved by random checks of chemstrip values compared to laboratory blood glucose values. If indicated further education and testing may be necessary. As well, nurses should be recertified for the chemstrip procedure on a yearly basis. The data analysis then has pointed to the value and importance of a comprehensive education program in relation to nursing competence and patient care outcomes in relation to this procedure.

CHAPTER V

Conclusions and Recommendations

Health care professionals are required to develop new knowledge, skills and attitudes to keep abreast of scientific and technological advances. This is necessary to ensure professional accountability in the provision of quality service to the public. Since the nursing profession holds a priviledged and responsible position in the health care system, it is crucial for the profession to develop the means whereby new knowledge, skills and attitudes are acquired and maintained by practitioners, thereby, safeguarding the health and well being of the public. A review of the literature reveals that in nursing the development of processes to ensure the ongoing competence of practitioners is gaining prominence. However, in some situations, current methods continue to be inadequate. The purpose of this study from a broad perspective was to examine nursing accountability by the testing of a nursing procedure. Specifically, the current accuracy of the chemstrip procedure by staff nurses was assessed. As well, the effects of a certification program for nurses on the accuracy of the chemstrip procedure were analyzed.

Seventy nurses and one hundred and twenty-three patients consented to participate in the study. As well, an undetermined number of laboratory technicians and assistants were indirectly involved in the study. The site of the study was the medical units of a large metropolitan hospital. Data were collected from nurses recordings of the chemstrip procedure and from the concurrent laboratory blood glucose determinations over a three month time frame. At the end of this three month time frame, the data included a total of seventy chemstrip recordings and seventy concurrent laboratory blood glucose recordings in the experimental group and sixty-eight chemstrip and sixty-eight concurrent laboratory blood glucose recordings in the control group.

Findings

The data analysis revealed that in the control group the accuracy of the nurses' performance of the chemstrip procedure was inadequate, and in some cases alarming. With the intervention of the certification program to the nurses, the accuracy of performance of the chemstrip procedure improved dramatically to an acceptable level. Further analysis revealed that proximity of time between the certification program and the performance of the chemstrip did not affect the accuracy level over the time frame of the data collection period to a significant degree. However, it is important to point out that the timeframe involved is relatively short and further testing is required to ensure ongoing accuracy.

Implications for Nursing

The results of this study point out the need for members of the nursing profession to carefully scrutinize their practice on an ongoing basis. Nursing activities must be systematically monitored in terms of nursing performance and patient care outcomes. It is clear that this evaluation is of vital importance since the health and well-being of patients are dependent on nursing interventions. Moreover, if nursing is to grow and evolve professionally, the evaluation of its practice must be an integral part of this process. However, evaluation of practice is only one component of the larger picture which is quality assurance. Quality assurance being a dynamic process provides a means to measure nursing accountability. Attitudes of nurses relative to quality assurance must change from a task-oriented segmented approach to an analytical, unifying approach. The challenge for nursing leaders today is to establish effective and efficient quality control systems which explicitly measure nursing accountability and which have credibility with nursing practitioners. In view of a global assessment, the findings from this particular study can be incorporated into the quality assurance structure of the study hospital. Standards of care relative to the chemstrip procedure which are clearly expressed and which can be objectively measured need to be formulated. In turn, these standards must be monitored, evaluated and acted upon when necessary. Further, policy must be drawn up for the chemstrip procedure which would involve an interdisciplinary effort. The policy statement would clarify who is covered to perform the procedure and the conditions under which an individual is allowed to proceed. For example, it may specify that only certified nurses in specific areas of a hospital be allowed to perform the procedure. The policy statement would also discuss recertification and the content and frequency of this process. A very crucial component of policy would address quality control and the mechanism which this entails. Procedure would include explicit instruction on how to perform the instructions regarding the chemstrip as well as the certification process. Moreover, other nursing procedures and practices must be examined and tested. Nurses must constantly ask questions and seek answers which ensure their accountability.

The results of the study point out the importance of ongoing staff education in contributing to the level of nursing competence which can be expected. Although the importance of education programs is implicitly recognized, there is still much work to be done in testing of the effectiveness of these programs. This study clearly establishes the effectiveness of a well planned and comprehensive educational program. The specific type of educational program, called a certification program, has gained widespread recognition by professional groups. Certification programs need to be comprehensive including a knowledge component, skill testing and evaluative component. However, even these more sophisticated programs have not been widely tested. This study suggests very strongly that the certification program developed in this particular case was highly effective in improving nursing performance in terms of the measurement of accuracy of the chemstrip procedure. Nevertheless, the long term effects of this particular program should be carefully examined and tested.

Another issue arising from this study deals with an important topic in the health care industry today: fiscal responsibility and accountability. Because quality assurance and educational programs are costly, there seems to be in some instances a prevailing attitude that in times of fiscal restraint, these programs are "frills" which can be cut without unduly affecting patient care. The results of this study challenges this assumption as it is shown that education, monitoring and evaluation are vital to ensure acceptable outcomes of patient care. However, this is not to downplay the importance of collective and individual responsibility for cost control. Quality assurance and education programs, since they are costly, must be examined diligently and frequently to determine their effectiveness. Moreover, new technology must be carefully scrutinized in terms of the effect it will have on the hospital budget. Risks and benefits as well as varying alternatives must be weighed diligently through inter-departmental and interdisciplinary effort, the goal being to reach a decision which will provide quality care at the least cost.

Retrospectively one can assess the actual situation of the introduction of the chemstrip procedure as a nursing responsibility in the study hospital. The results of this study clearly indicate that the procedures used to familiarize nurses with the technique as well as the followup were less than adequate as judged by the negative impact on patient care. Therefore, one must assess why and how this could happen and how a similar situation could be avoided in the future. Unfortunately, the general assumption relative to this procedure was that it was being done properly and that the results were accurate. The study clearly demonstrated that no such assumption can or ought to be made for this or any other nursing procedure. All nursing activities and procedures must be evaluated so that there is objective data to ensure quality of patient care outcomes. When a new nursing procedure is introduced, the process must include an evaluative component. If this can not be assured, the procedure ought not be introduced. Nursing departments must be very cautious as they are constantly under pressure to introduce new technologies. The potential benefit to the patient must be paramount in considering any new innovation. As well, it is crucial that in assessing the introduction of new technologies that inservice education time be included in the budget assessment.

The study reveals the critical importance of effective interdepartmental communication in the management of patient care and professional practice standards. When decisions are taken to establish new procedures and techniques or to monitor and evaluate those which exist, the approach ought to be one of collaboration and mutual support. All health care professionals must come to the realization that hope for the future rests in mutual collaboration. There must be room for challenge as well as support in a spirit of open inquiry and honest dialogue; with the ultimate objective of all health disciplines being to achieve the best possible care for the patients whom they serve. Specifically, this study points out the crucial importance of nursing, medicine, and laboratory staff working very closely together in the establishment of standards of care, criteria for quality control, and procedures and policies to ensure the establishment and maintenance of a safe and accurate chemstrip procedure in the study hospital. When various disciplines collaborate in the delivery of patient care, the strengths of the various departments can enhance each other. The strength of the laboratory staff relative to their knowledge and skills in quality control of laboratory testing can be helpful to nursing staff who may perhaps not had the opportunity to develop an appreciation of the importance of these matters.

It must be pointed out that the findings of this study can't be generalized to other areas of the study hospital, or to other hospitals and agencies without first reflecting on other variables which may exist. There must be an assessment of the nature of existing educational programs and their effectiveness. As well, one must establish the frequency with which the chemstrip procedure is done by nurses in an area, as it has been pointed out that it may be difficult to maintain competence if the number of chemstrip procedures performed is minimal. This study only tested the visual chemstrip procedure; if reflectometers or other test strips are used, other elements are introduced which may affect accuracy. The follow-up to this study would include the establishment of a quality control mechanisms co-ordinated by the laboratory staff working in conjunction with nursing. This would contain a provision for a random accuracy checks on an ongoing basis and recertification of the nurses when appropriate as measured by the results of the quality control program. As well, the standards of care should be monitored to ensure maintenance of established criteria. With all these activities and monitoring systems in place, nursing accountability in performing the chemstrip procedure should be acceptable.

Recommendations for Further Research

This study corroborated findings from previous studies. The unique finding was the identification of the link between a comprehensive education program and the accuracy of the visual chemstrip procedure. With this in mind, the following specific recommendations are made for future research studies.

1. A replication of this study should to be done in other areas of the hospital such as surgical units and obstetrical units. In these areas frequency of performance of the test is more limited than on medical units and it would be interesting to determine if there is a minimum number of chemstrips which should be performed to ensure acceptable levels of accuracy.
2. A replication of this study 12 months later on the same medical units to determine if the recertification is as effective as the actual certification process would be of interest. The study could employ the same research design. The experimental group would include the nurses who go through the recertification process; the control group would include the nurses who have not yet been recertified. The study would determine the effectiveness of recertification as well as the longevity of effectiveness of the original certification program.
3. It is important to determine on an ongoing basis the accuracy of the chemstrip procedure throughout a hospital. This could be determined by random spot checks of nurses performing the chemstrip with a

concurrent laboratory blood glucose for comparison. This procedure would need to employ proper standards for quality control and should be carried out collaboratively by nursing and the laboratory staff.

4. Further studies to test the accuracy of the various meters relative to visual methods should be planned and carried out.
5. It is crucial to address other nursing procedures in a similar fashion to this analysis. In this study the findings revealed that the accuracy of the existing chemstrip procedure performed by the nurses was unacceptable; these findings are helpful in that they point the way to developing new methods to ensure that the procedure is safe and accurate; such new methods would include the administration of the certification program to nurses expected to perform chemstrip readings. One must then ask the questions about the effectiveness and accuracy of other nursing procedures. If there are questions about the accuracy of any nursing activity or procedure, it should be addressed and studied.

The major contribution of this study may be seen as underscoring questioning and testing nursing practice. Finding appropriate answers in many cases involves nursing research activity. However, nursing research needs to be envisioned in a broad context and includes any activity which contributes to the acquisition of new nursing knowledge. These activities include literature reviews, educational programs, clinical trials, nursing audits, policy and procedure updates to name a few, as well as the more rigorous scientific nursing studies. All of these activities are important and necessary to expand the nursing knowledge base. A dynamic and innovative nursing division will provide the structure, process and support to enable this research activity to occur. If research is seen in this broad context, nurses will become more convinced about and attuned to the importance of this activity. Since clinical nurses are the nurses who ask the most important questions relative to patient care, it is crucial for them to focus their practice in this direction. With the acquisition of new knowledge and skills gleaned from research activity nursing practitioners are more apt to confidentially and effectively carry out the mandate of their mission. Consequently, professional accountability be ensured and the patient will reap the benefit in terms of enhanced levels of care. This research project has demonstrated how patients can benefit from nursing research activity.

References

Aiken, L.H. (1982). Nursing in the 1980's: Crisis, opportunities and challenges. Philadelphia: J.B. Lippincott Co., 1982.

Alberta Association of Registered Nurses, College of Physicians and Surgeons, and Alberta Medicine Association 1987, Guidelines for medical nursing responsibilities.

Alberta Association of Registered Nurses. Nursing Practice Standards, 1980. Edmonton:

Almond, J. (1986). Measuring blood glucose levels. Nursing Times, Oct. 8, 51-54.

American Nurses Association. Standards of Nursing Practice, 1973, NP-41. Kansas City: Congress for Nursing Practice.

American Nurses Association, (1979). The Report of the Committee for the study of credentialing in nursing. American Journal of Nursing April 1, 1979, p.p. 677-679.

Andrews, S., Cooke, P.R., & Went, J. (1982). A quality-control scheme for ward-based blood glucose estimation. Medical Laboratory Science, 40, 279-282.

Aydelotte, M.K. (1978). The future health delivery system and the utilization of nurses prepared in formal education programs in Chaska, N.L. The nursing profession: views through the mist. New York: McGraw-Hill Book Co., 349-358.

Aydelotte, M.K. (1987). Nursing's preferred future. Nursing Outlook, 3, 114-120.

Aziz, S. & Hsiang, Y.H. (1983). Comparative study of home blood glucose monitoring devices: visidex, chemstrip bG, glucometer and accu-chek bG. Diabetes Care, 6, 529-532.

Banning, J. Runaway technology? Ed. (1986). Canadian Nurse, 9, 5.

Barr, B., Leichter, S.B. & Taylor, L. (1984). Bedside capillary glucose monitoring in the general hospital. Diabetes Care, 3, 26-264.

Barsevich, A. & Llewellyn, J. (1982). A comparison of the anxiety reducing potential of two techniques of bathing. Nursing Research, 1, 22-27.

Beckman, J.S. (1987). What is a standard of practice? Journal of Nursing Quality Assurance, 2, 1-6.

Benner, P. (1984). From novice to expert: excellence and power in clinical nursing practice. Reading Mass: Addison-Wosley.

Block, D. (1977). Criteria, standards, norms: crucial terms in quality assurance. Journal of Nursing Administration, Sept., 20-30.

Boone, M. & Kikuchi, J. (1977). The clinical nurse specialist in LaSor, B & Elliot, M. Issues in Canadian Nursing. Scarborough: Prentice Hall. 101-125.

Cahill, G.F., Etzwiler, D.D., & Freinkel, N. (1977). Control and diabetes. New England Journal of Medicine, 296, 1004-1005.

Calkin, J. (1987). Specialization in nursing: certification. The Nursing Report, 4, 27-36.

Campbell, D.T. & Stanley, J.C. (1966). Experimental and quase-experimental design for research. Chicago: Rand-McNally.

Chiasson, J.L., Morrisset, R., & Hamet, P. (1984). Precision and costs of techniques for self-monitoring of serum glucose levels. Canadian Medical Association Journal. 130, 38-44.

Christman, L.P. (1978). Alternatives in the role expression of nurses that may affect the future of the nursing profession. In Chaska, N. The nursing profession: views through the mist. New York: McGraw Hill Book Co., 359-365.

Christman, L.P. (1987). A view to the future. Nursing Outlook, 5, 216-218.

Clark, P.E. & Clark, M. J. (1984). Therapeutic touch: is there a scientific basis for the practice. Nursing Research, 1, 37-41.

Conway, M.E. (1985). Towards greater specificity in defining nursing's meta paradigm. Advances in Nursing Science, 4, 73-81.

Committee on Monitoring Devices: Canadian Association of Pathologists. Guidelines on the use of blood glucose meters and nonmeter blood glucose reagent strips in hospitals (1988). Canadian Medical Association Journal, (138) 1, 27-29.

Cousins, N. (1979). Anatomy of an Illness. NY: W.B. Norton Co., 111.

Cox, J. (1985). Report on the forth-first annual convention. Newsletter of the Catholic Healthcare Conference of Alberta, 11, 1, 4-5.

Creighton, H. (1987). Legal implications of policy and procedure manuals. Nursing Management, 18 (4), 22-4.

Curtin, L. & Flaherty, J. (1982). Nursing ethics: theories and pragmatics, Bowie: Robert J. Brady Co., p. 72.

Davidson, R.A. & Lauver, D. (1984). Nurse practitioner and physician roles: delineation and complementarity of practice. Research in Nursing and Health, 7, 3-9.

Davis, A.J. (1978). The phenomenological approach in nursing research. In Chaska, N. The nursing profession: views through the mist. New York: McGraw-Hill, Book Co., 186-196.

Davis, A.E. (1987). Comparing the effectiveness of two teaching methods for neurological assessment. Journal of Nursing Staff Development, (3) 3, 138-140.

Davis, A.J. & Aroskar, M.A. (1978). Ethical dilemmas and nursing practice. New York: Appleton-Century-Crofts.

Davis, M.Z. (1981). Promoting nursing research in the clinical setting. The Journal of Nursing Administration, 3, 1981.

Dolan, J., Fitzpatrick, M., & Herrmann, E. (1983). Nursing in society: a historical perspective. Philadelphia: W.B. Saunders Co., p. 361.

Dolphin, P. & Holtzclow, B.J. (1983). Continuing education in nursing. Reston: Prentice-Hall Co., 195-201.

Donabedian, A. (1980). Explorations in quality assessment and monitoring Volume II: The definition of quality and approaches to its assessment. Ann Arbor Michigan: Health Administration Press.

Donaldson, S.K. and Crowley, D.M. (1978). The discipline of nursing. Nursing Outlook, 26, 113-120.

Doyle, M. (1987). role of the clinical nurse specialist. Nursing Administration Quarterly, 11 4, 53-54.

Drew, J. (1984). Certification: answers to some questions. Rehabilitation Nursing, 3, 15-16.

Drew, D. & Schumann, D. (1986). Homogeneity of potassium chloride in small volume intravenous containers. Nursing Research, 6, 325-329.

Drucker, R.F., Williams, D.R.R., & Price, C.P. (1983). Quality assessment of blood-glucose monitors in use outside the hospital laboratory. Journal of Clinical Pathology, 36, 948-953.

Elliot, D. The Nursing Profession Act: an achievement for Alberta nurses. In Storch, J., Chapman, Y., Elliot, D., Kerr, J. (1984). Canadian Nurse, 10, 50-52.

Ehrat, K.S. (1987). The cost-quality balance: analysis of quality, effective, efficiency, and cost. Journal of Nursing Administration, 5, 6-9.

Fairclough, P.K., Clements, J.R., Filer, D., & Bell, D (1983). An evaluation of patient performance of, and their satisfaction with, various rapid blood glucose measurement systems. Diabetes Care, 6, 45-49.

Farmer, E.S. (1981). In Hockey, L. Current issue in nursing. Edinburgh: Churchill Livingstone, 33-45.

Faherty, B.S. & Grier, M.R. (1984). Analgesic medication for elderly people post surgery. Nursing Research, 6, 369-372.

Flaherty, J. (1979). Nursing Expertise in Canada. In Zilm, G., Larose, O., Stinson, S. Ph.D. (Nursing), Ottawa, Canadian Nurses Association.

Flynn, K. (1984). Role issues: technology and economics in hospital nursing. Hospital Topics, 3, 27-29.

Ford, S.; Redmond, I.; Roach, F. (1979). A pilot course on word teaching methods. Nursing Times 75, 13-16.

Forrest, A.R.W. (1979). Ward measurement of blood glucose. Journal of Clinical Pathology, 32, 967-970.

Frindik, J.P., Kassner, D.A., Pirkle, M.T., Kemp, F., & Hoff, C. (1983). Comparison of visdex and chemstrip bG with Beckman glucose analyzer determination of blood glucose. Diabetes Care, 6, 536-539.

Fry, S.T. Accountability in research: the relationship of scientific and humanistic values. Advances in Nursing Science, 4, (1), 1-13.

Gataint, L.I. (1987). The image of the nurse: a nursing perspective. Alberta Association of Registered Nurses Newsletter, 9, 5.

Gedan, E.A. (1982). Effects of lifting techniques on energy expenditure: a preliminary investigation. Nursing Research, 4, 214-218.

Ginsburg, I. (1982). Is a holistic model salutary? Nursing Homes, Sept., Oct., 32-40.

Godine, J. E., Hurxthal, K., Nathan, D.M. (1986). Bedside capillary glucose measurement by staff nurses in a general hospital. American Journal of Medicine, 5, 803-806.

Gortner, S.R. (1974). Scientific accountability in nursing. Nursing Outlook, 12, 764-768.

Gortner, S.R. (1983). The history and philosophy of nursing science and research. Advances in Nursing Science, 512, 1-8.

Guarriello, D.L. (1984). The legal booby traps in nursing standards. Registered Nurse, 6, 19-21.

Guidelines for the delegation of a medical act, (1988). A Canadian Medical Association Position. Canadian Medical Association Journal, 1, 168A.

Harris, R.B. & Hyman, R.B. (1984). Clean versus sterile tracheotomy care and level of pulmonary infection. Nursing Research, 2, 80-85.

Harris, H. (1986). Point: for certification of nursing staff development educators. Journal of Nursing, Staff Development (2), 1, 5-9.

Hasler, M.E. & Cohen, J.A. (1982). The effect of oxygen administration on oral temperature assessment. Nursing Research, 5, 265-268.

Henderson, V. (1978). The concept of nursing. Journal of Advanced Nursing, 3, 113-130.

Hinshaw, S.K. (1977). The nurse practitioner movement from Miller, M.H. & Flynn B.C. Current perspectives in nursing: social issues and trends. Saint Louis: C.V. Mosbey Co., 80-93.

Hernandez, C. (1983). Home blood glucose monitoring mind over meter! Diabetes Dialogue, Spring, 41-49.

Hockey, L. (1981). Communication in nursing: The Nursing Research Unit: University of Edinburgh Part I. Nursing Times, 77, 597-8.

Holmes, P. (1984). Holistic nursing. Nursing Times, April 18, 28-29.

Hinshaw, A.S. (1988). Using research to shape health policy. Nursing Outlook, 1, 21-24.

Hilton, B.A. (1982). Nurses' performance and interpretation of urine testing and capillary blood glucose monitoring measures. Journal of Advanced Nursing, 7, 509-521.

Hunt, J. (1981). Indicators for nursing practice: the use of research findings. Journal of Advanced Nursing, 6, 189-194.

Ikeda, Y., Jajima, N., Minami, M., Ide, Y., Jokoyama, J., & Abe, M. (1978). Pilot study of self measurement of blood glucose using the dextrostix-eyetone system for juvenile-onset diabetes. Diabetologia, 15, 91-93.

Irsigler, K., & Bali-Taubald, C. (1980). Self-monitored blood glucose: The essential biofeedback signal in the diabetic patient's effort to achieve normoglycemia. Diabetes Care, 3, 163-170.

Jachovsky, B.J. (1985). Indirect auscultatory blood pressure measurement at two sites in the arm. Research in Nursing and Health, 8, 125-129.

Johnson, D.E. (1959). A philosophy of nursing. Nursing Outlook, 4, 198-200.

Joyce, M.A., Kuzick, C.M., & Murphy, D.M. (1983). Those new blood glucose tests. Registered Nurse, April, 46-52.

Jovanovic, L., & Peterson, C.M. (1980). Management of the pregnant, insulin-dependent diabetic woman. Diabetes Care. 3, 63-68.

Keil, O. & Widmann, D.E. (1984). Assessment of the impact of medical devices on the quality of care. Quality Review Bulletin, 9, 278-280.

Keller, E. & Bzdek, V.M. (1986). Effects of therapeutic touch on tension headache pain. Nursing Research, 2, 101-105.

Kerr, J.C. (1973). Provincial variations in nursing functions. In Good, S.R. & Kerr, J.C. (1973). Contemporary Issues in Canadian Law for Nurses. Tor: Holt, Rinehart, and Winston of Canada. p. 83-94.

Kerr, J.C. (1983). Yesterday, today and tomorrow: a profession in transition. Alberta Association of Registered Nurse, 5, 3-7.

Kikuchi, J., Conrad, A., Prokopczak, D., Roberts, D. & Smith, P. (1982). Towards a research based nursing practice. A paper presented at the Canadian Nurses Association Annual Meeting. St. John's, Newfoundland.

King, I.M. (1981). A theory for nursing: systems, concepts, process. New York: John Wiley & Sons, 1981a, 2.

Kirchhoff, K.T., Rebenson-Piano, M. & Patel, M.K. (1984). Mean arterial pressure readings: variations with positions and transducer level. Nursing Research, 6, 343-345.

Krumme, U.S. (1975). The case for criterion-referenced measurement. Nursing Outlook, 23, 547-553.

Krueger-Wilson, C. (1986). Strategies for monitoring the cost and quality of care. Journal of Nursing Quality Assurance, Nov., 55-65.

Leininger, M. Futurology of nursing: goals and challenges for tomorrow. In Chaska, N.L. (1978). The Nursing Profession: views through the Mist. New York: McGraw-HillBook Co., 379-396.

Levesque, V.D. (1985). Specialization and certification: a review of CNA's activities. Canadian Nurse, 6, 26-28.

Lombrail, P., Cathelineau, G., Gervais, P., & Thibult, M.S. (1984). Abnormal color vision and reliable self-monitoring of blood glucose. Diabetes Care, 7, 318-321.

Long, G. (1982). The effects of medication distribution systems on medication errors. Nursing Research, 3, 182-184.

Luckenbill-Brett, J.L. (1987). Use of nursing practice research finding. Nursing Research, 6, 344-349.

Mason, E. (1984). How to write meaningful nursing standards 2nd ed. New York: Wiley, Co., 2.

McCaffrey, C. (1978). Performance checklists: an effective method of teaching, learning and evaluating. Nurse Education, 3, 11-13.

McCann-Flynn, J.B. (1984). Nursing from concept to practice. Bowie, Maryland: Brady Communications Co., Inc., 92.

McCloskey, J.C. (1981). The effects of nursing education on job effectiveness: an overview of the literature. Research in Nursing and Health, 4, 355-373.

McNeil, L. (1983). Self blood glucose monitoring: an update. Diabetes Education, Winter, 15-18.

Megal, M.E., Wilken, M.K., & Volcek, M.K. (1987). Nursing students' performance: administering infections in laboratory and clinical area. Journal of Nursing Education, 7, 288-293.

Merry, M.D. (1987). What is quality care? A model for measuring health care excellence. Quality Research Bulletin, Sept., 298-301.

Meservy, D. & Monson, M.A. (1987). Impact of continuing education on nursing practice and quality of patient care. The Journal of Continuing Education in Nursing, 6, 214-220.

Metheny, N.A., Spies, M. & Eisenberg, P., (1986). Frequency of nasoenteral tube displacement and associated risk factors. Research in Nursing and Health, 9, 241-247.

Mills, W. (1988). Q.A. and its "Kissing Cousin"... R.M. Alberta Association Registered Nurse Newsletter, Jan., 12-13.

Mills, W. (1988). The Q.A. - R.M. Relationship. Alberta Association of Registered Nurse Newsletter, Feb., 14-15.

Morse, J., & Conrad, A. (1983). Putting research into practice. Canadian Nurse, 8, 40-43.

Murphy, J.F. (1978). Toward a philosophy of nursing. In Chaska, N.L. The Nursing Profession: Views through the Mist. New York: McGraw-Hill Book Co., p. 3-9.

National Centre for Health Services Research, Research Summary Series, (1978). Criterion measures of Nursing Care Quality Washington: Department of Health Education and Welfare.

Nelson, D. (1986). Cost containment: nurses can help. Hospital Material Management Quarterly, 8, 11, 20-2.

Nichols, E.G., Barstow, R.E. Cooper, D. (1983). Relationship between incidence of phlebitis and frequency of changing IV tubing and percutaneous site. Nursing Research, 4, 247-252.

Notter, L.; Robey, M.C.; Weinstein, M.H.: (1978). Guidelines for implementation of open curriculum practices in nursing education NLN #19-1701 1-24.

Orem, D.E. (1980). Nursing: concepts of practice 2nd edition. New York: McGraw-Hill Book Co., 32.

Orzeck, E.A. (1982). Home blood testing today. Diabetes Forecast, 6, 35-38.

Orzeck, E.A. (1983). What's new in blood glucose self-testing. Consultant, Aug., 93-106.

Parsons, L.C. & Wilson, M.M. (1984). Cerebrovascular status of severe closed head injured patients following passive position changes. Nursing Research, 2, 68-75.

Paulen, A. High touch in a high tech environment. Career Nursing. Editorial, 6, 1984.

Pelle, D. (1986). an integrative approach to quality assurance. Journal Nursing Quality Assurance, Nov., 8-16.

Phaneuf, M.C. & Wandelt, M.A. (1981). Three methods of process orientated nursing evaluation. Quality Reviews Bulletin, 7, 8, 20-26.

Pick, J. (1984). Specialization in nursing: will we find a way to meet the need. Canadian Nurse, 5, 22-23.

Poe, S.S. & Will, J.C. (1987). Quality nurse-patient outcomes: a framework for nursing practice. Journal Nursing Quality Assurance, 1, 29-37.

Poteet, G.W., Reinert, B. & Ptalc, H.E. (1987). Outcome of multiple usage of disposable syringes in the insulin requiring diabetic. Nursing Research, 6, 350-352.

Putt, A.M. (1978). General systems theory applied to nursing. Boston: Little Brown and Company.

Reid, E. (1986). Quality assurance performance indicators: the DHSS Pl package. Nursing Times, 82, 37, 44,46,48.

Rogers, M.E. (1970). An introduction to the theoretical basis of nursing. Philadelphia: FA Davis Co.

Rogers, S. (1976). Testing the RN students' skills. Nurse Outlook, 24, 446-449.

Rogers, M.E. (1980). Nursing: a science of unitary man. In J.P. Riehl and C. Roy, Eds., Conceptual models for nursing practice, 2nd ed. New York: Appleton-Century-Crofts, 329-337.

Roy, C. (1976). Introduction to nursing: An adaptation model. New Jersey: Prentice-Hall Co., 3.

Schlotfeldt, R.M. (1977). Nursing research: reflection of values. Nursing Research, 1, 4-7.

Schlotfeldt, R.M. (1987). Defining nursing: a historical controversy. Nursing Research, 1, 64-67.

Schlotfeldt, R.M. (1981). Nursing in the future. Nursing Outlook, 5, 295-301.

Schiffman, R.F. (1982). Temperature monitoring in the neonate. Nursing Research, 5, 274-277.

Schiffren, A., Desrosiers, M., & Belmonte, M. (1983). Evaluation of two methods of self-blood glucose monitoring by trained insulin dependent diabetic adolescents outside the hospital. Diabetes Care, 6, 166-169.

Schroeder, P. & Mainbusch (1984). Nursing Quality Assurance. Rockvill: Aspen Publishers.

Scott, B. (1982). Competency based learning: a literature review. International Journal Nursing Studies. 19 3, 119-124.

Scrima, D.A. (1987). Assessing staff competency. Journal of Nursing Administration. 2, 41-45.

Shannahan, M.D. & Hansen, B. (1985). Effect of the birth chair on duration of second stage labor outcome and maternal blood loss. Nursing Research, 2, 89-92.

Shapiro, B., et al. (1981). A comparison of accuracy and estimated cost of methods of home blood glucose monitoring. Diabetes Care, 4, 396-403.

Shaver, J. (1986). High touch nursing in a high tech world. Canadian Nurse, 5, 16-19.

Skyler, J.S., Lasky, I.A., Skyler, D.L., Robertson, E.G., & Mintz, D.H. (1980). Blood glucose control during pregnancy. Diabetes Care, 3, 69-76.

Smith, J.H. (1983). Laboratory staff and nurse's performance compared when using the blood glucose Reflotest-reflectomat system. Med Lab Sciences, 40, 283-285.

Sonksen, P.H., Judd, S.L., & Lowy, L. (1978). Home monitoring of blood glucose. Method for improving diabetic control. Lancet, 1, 729-732.

Sonksen, P.H., Judd, S. & Lowy, C. (1980). Home monitoring of blood glucose: new approach to management of insulin dependent diabetic patients in Great Britain. Diabetes Care, 1, 100-107.

Sovie, M.D. (1978). Nursing: a future to shape. In Chaska, N.L.. The Nursing Profession. New York: McGraw-Hill Book Co., 366-377.

Sovie, M.D. (1981). Unifying education and practice: one medical center's design. Pt. 2. Journal of Nursing Administration, 11, 30-32.

Spady, W.G. (1977). Competency-based education: a bandwagon in search of a definition. Educ. Res., 6, 9-14.

Storch, J., Chapman, Y., Elliot, D. & Kerr, J.C. (1984). The Nursing Profession Act: an achievement for Alberta nurses. Canadian Nurse, 10, 49-55.

Storch, J. (1982). Patients' rights: ethical and legal issues in health. Scarborough: McGraw-Hill Ryerson.

Turner, S. (1987). Teaching CPR as a motor skill. Journal of Nursing Staff Development, (3), 2, 80-81.

Vanbree, N.S., Hollerbach, A.D., & Brooks, G.P. (1984). Clinical evaluation of three techniques for administering low-dose heparin. Nursing Research, 1, 15-19.

Vezina, M.L. (1984). Certification: implications for nurses. Nursing Forum, 3, 109-116.

von Bertalanffy, L. (1968). General systems theory: A critical review. In Buckley, W. (Ed) Modern systems research for the behavioral scientist. Chicago: Aldine Publishing.

Walford, S., Clarke, P., Poisey, R., Harlog, M., & Allison, S.P. (1978). Home blood glucose measurement without reflectometer. Lancet, 1, 653-654.

Wandelt, M. & Phaneuf, M. (1972). Three instruments for measuring the quality of nursing care. Hospital Topics, 8, 20-24.

Walsh, C.M., Bada, H.S., Korones, S.B., Carter, M.A., Wong, S.P. & Arheart, K. (1987). Controlled supplemental oxygenation during tracheobronchial hygiene. Nursing Research, 4, 211-215.

Watson, J. (1979). Nursing: the philosophy and science of caring. Boston: Little Brown and Co.

Westfall, U.E. (1987). Standards of practice: Nursing values made visible. Journal Nursing Quality Assurance, 2, 21-30.

White Surr, C. (1983). Teaching patients to use the new blood glucose monitoring products. Nursing, 1, 42-45.

Williams, J., & Freedman, Z. (1984). Evaluation of hospital staff nurse performance of chemstrip bG testing. Diabetes Care, 7, 398-399.

Williamson, M.L. (1982). Reducing post catheterization bladder dysfunction by reconditioning. Nursing Research, 1, 28-30.

Wilson, C.K. (1986). Strategies for monitoring the cost and quality of care. Journal Nursing Quality Assurance, 1, 55-65.

Wing, R.R., Kelske, R., New, A., Lamparski, D. & Becker, D. (1986). Behavioral skills in the self-monitoring of blood glucose: relationship to accuracy. Diabetes Care, 4, 330-333.

CERTIFICATION PROGRAM

MAJOR GOALS AND OBJECTIVES:

1. To promote and maintain a high degree of staff proficiency for blood glucose testing through providing quality education, initial certification, and recertification.
2. To ensure compliance with the accepted program of quality assurance.
3. To remain current with standards of diabetes care and update applicable hospital procedures and policies.
4. To be able to troubleshoot Chemstrip bG and initiate remedial action if necessary.

IMPLEMENTING THE PROGRAM

1. A comprehensive training program will be initiated that will include in-servicing, certification and recertification of all personnel on a continuing basis. A Boehringer Mannheim Diagnostics representative will be involved in the initial in-service. This representative will orient all "core group personnel" to acquaint them with more detailed information pertaining to the testing procedure(s). All subsequent in-services will be conducted by core group personnel.

2. The expertise of clinical laboratory personnel will be co-opted to initiate and maintain quality assurance aspects of the program.

3. Documents necessary for training and record keeping will be prepared and approved for use.

4. Upon completion, the program will be organized as a working document and reviewed for authorization by the appropriate Vice President's. The Laboratory Director and Director of the Metabolic Unit will participate in the review process to ensure that the procedures and policies conform with regulatory requirements.

The_U.S. Joint Commission on Accreditation of Hospitals has stated that hospitals performing reagent strip ancillary testing must meet the following minimum requirements:

1. Personnel assigned to perform such testing must be qualified through training and this training must be documented.

2. There should be written procedures and policies for test performance, quality control, and reagent acquisition and storage.

3. Quality Control must be implemented and documented.

4. A basic accession record to include (at a minimum) the patient, test and date should be maintained to correlate with documented quality control results. The guidelines state that the documentation of patient results must be easily cross referenced with the quality control results. This requires that serial numbers and lot numbers of the products in use be recorded along with all test results, whether they are patient or control values.

CAPILLARY BLOOD GLUCOSE CERTIFICATION PROGRAM

GOAL:

To ensure reliability of capillary blood glucose testing results.

OBJECTIVE 1

The certification program will contain the following components:

a. Pre-test material.
b. Discussion and theory.
c. Demonstration.
d. Redemonstration.
e. Post-test
f. Clinical demonstration to a certified instructor or designee of an accurate capillary blood glucose test.
  i. Certification records will be maintained on each unit by the appropriate supervisor.
  ii. No personnel may perform the test without certification or observation by a certified instructor or designee.

OBJECTIVE 2

Yearly recertification is mandatory and is the responsibility of each individual. Recertification will include:

a. Correct demonstration of the capillary blood glucose testing technique to a certified instructor or designee.
b. Testing by designated staff to include scheduled quality control monitoring using unknown glucose solutions. Provision of solutions and statistical analysis will be done from the Department of Laboratory Medicine in conjunction with the diabetes care co-ordinator.

OBJECTIVE 3

Quality Control will be maintained by:

a. Program of certification and recertification.
b. Revised Diabetes Record form. Concurrent laboratory glucose values and nursing unit bedside results will be recorded in adjacent columns for ready comparison.
c. Testing by designated staff to include scheduled quality control monitoring using unknown glucose solutions. Provision of solutions and statistical analysis of data will be done by personnel from the Department of Laboratory Medicine in conjunction with the diabetes care co-ordinator.

POLICY FOR CAPILLARY BLOOD GLUCOSE CERTIFICATION PROGRAM

a. Vice Presidents, Medical and Nursing shall be responsibile for designating those instructors that will form the core group for implementing a certification program.

b. Upon certification the following hospital personnel may, on written order of the attending physician or his designee (student intern, intern, or resident), perform a blood glucose test using capillary blood:

- Registered nurses
- Registered psychiatric nurses
- Graduate nurses
- Student nurses
- Registered nursing assistants
- Laboratory technologists
- Laboratory assistants
- Student interns, interns, residents
- Physicians

c. A quality control program will be co-ordinated with the Department of Laboratory Medicine and the Diabetes Care Coordinator.

Name ______________________________

CHEMSTRIP bG VISUAL METHOD TEST

This exam is comprised of two sections. Section A contains multiple choice questions and Section B true and false questions. Please indicate your choice(s) of answer(s) with a check mark ( ).

SECTION A

1. Proper cleansing method of the puncture site is to:
    ____a. wash hands with soap and water.
    ____b. use alcohol.
    ____c. use soap and water or alcohol.
    ____d. use Betadine.

2. The proper site for a finger puncture is:
    ____a. middle (pad) of finger
    ____b. top of fingertip
    ____c. side edge of finger
    ____d. under nail

3. Timing method should be done by using:
    ____a. estimation
    ____b. second hand on watch or clock
    ____c. egg timer
    ____d. verbal counting by 1-1000

4. The blood must be removed from the strip at:
    ____a. 30 seconds
    ____b. 60 seconds
    ____c. 120 seconds
    ____d. 180 seconds

5. The blood is removed from the Chemstrip bG by
    ____a. water.
    ____b. alcohol.
    ____c. cotton ball.
    ____d. shaking.

6. After removing the blood from the reagent area, wait an additional ____ seconds before comparing colors with the color chart.
    ____a. 60 seconds
    ____b. 90 seconds
    ____c. 120 seconds
    ____d. 180 seconds

7. Chemstrip bB colors can be compared to
    ____a. any Chemstrip vial.
    ____b. only the vial in which the strip is packaged.
    ____c. color chart on uGK vial.
    ____d. uGK color chart.

8. Abnormal quality control results should be followed up by:
   ____a. troubleshooting to determine cause of error.
   ____b. review of proper test technique.
   ____c. verifying expiration date on Chemstrip bG and control solution.

SECTION B

1. There is no expiration date on Chemstrip bG.
   ____True ____False

2. The Chemstrip bG may be stored in the refrigerator.
   ____True ____False

3. The size of the drop of blood will not affect the result.
   ____True ____False

4. For accurate results, apply drop of blood with one application rather than retouching reagent area multiple times.
   ____True ____False

5. It is important to firmly press finger to strip and smear drop of blood to cover entire reagent area.
   ____True ____False

6. It is important to blot the blood from the strip in order to remove all blood residue.
   ____True ____False

7. If blood glucose results are greater than 16.7 mmol/L, wait an additonal 90 seconds before making final comparison.
   ____True ____False

8. The reagent strip should only be read in a darkened room to prevent further color change.
   ____True ____False

9. Blood glucose results are obtained by comparing reagent area to color chart on vial.
   ____True ____False

10. If one of the test strip's colors matches the top half of vial's color block, and the other color matches the bottom half of the adjacent color block, you must estimate blood glucose value for test strip as falling between the blood glucose values corresponding to the two color blocks on the vial color chart.
    ____True ____False

11. The exact time the test is completed should be recorded on the diabetes record.
    ____True ____False

12. The purpose of doing quality control procedures is to assure accurate readings from Chemstrip bG test strips.
    ____True ____False

CHEMSTRIP bG VISUAL KEY

SECTION A

1. c
2. c
3. b
4. b
5. c
6. a
7. b
8. a,b,c

SECTION B

1. False
2. False
3. False
4. True
5. False
6. False
7. False
8. False
9. True
10. True
11. True
12. True

Name______________________________________

CHEMSTRIP bG VISUAL METHOD TEST

ANSWER SHEET

SECTION A

1. a b c d
2. a b c d
3. a b c d
4. a b c d
5. a b c d
6. a b c d
7. a b c d
8. a b c

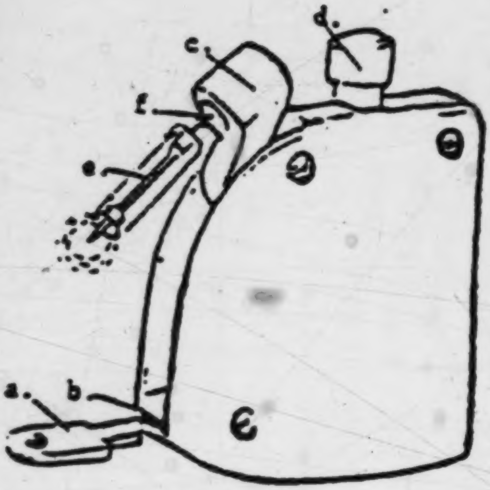
SECTION B

1. T F
2. T F
3. T F
4. T F
5. T F
6. T F
7. T F
8. T F
9. T F
10. T F
11. T F
12. T F

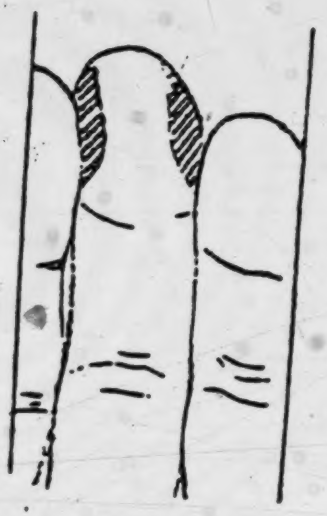
GUIDELINES FOR USE OF THE AUTOLET*

PURPOSE: To obtain a capillary blood sample from a finger

GENERAL INFORMATION: The autolet is an automatic device for obtaining a capillary blood sample. It produces a rapid puncture to a controlled depth, with instantaneous retraction of the lancet.



a. autolet platform
b. slot
c. autolet arm
d. activating arm
e. lancet
f. socket



EQUIPMENT:

1. autolet
2. lancet
3. autolet platform
4. alcohol swab (optional)
5. cotton balls or white tissue

PROCEDURE:

1. Explain the procedure to the patient.
2. a. Ambulatory patient - Instruct the patient to wash his hands with warm water and soap and to dry his hands thoroughly.

   b. Non-ambulatory patient - Wipe the area to be punctured with an alcohol swab and allow the area to air dry; or wash with warm water and soap and dry thoroughly.
3. Instruct the patient to hang his arm at his side for 30 seconds to promote blood flow to the fingertips.

4. Select the appropriate puncture site: i.e. finger pads in shaded areas as illustrated in figure 2.

5. Insert the platform into the slot at the base of the autolet ensuring that the recessed side of the platform is facing downwards. Platforms are for multiple use - replace if damaged or contaminated.

6. Pull the autolet arm back towards the activating button until it clicks into position and is held.

7. Insert the lancet into the sprung socket in the arm and push firmly into position. Any slight slackness in the seating may be taken up by rotating the lancet about a quarter of a turn.

8. Remove the plastic disc from the end of the lancet by twisting it off and exposing the needle.

9. Place the recessed surface of the platform firmly against the site so that the tissue protrudes into the hole in the centre of the platform.

10. Apply slight pressure to the activating button, allowing the lancet to instantaneously puncture the skin and retract.

11. Collect the required amount of blood.

12. Once blood collection is complete, apply pressure to the puncture site using tissue or a cotton ball.

13. Remove the lancet and discard in the designated sharps container.

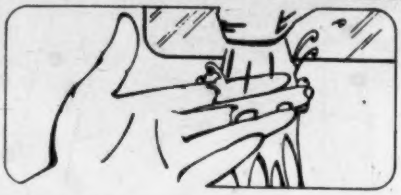
14. Maintain the autolet arm in the downward position after use to avoid overstraining the spring.

15. Cleanse the platform with soap and water to leave it ready for the next use.

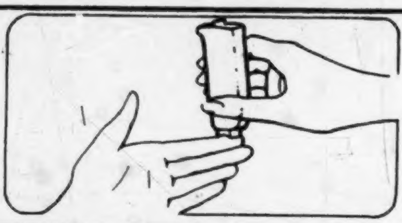
*Registered Trade Mark - Ulster Scientific Inc., New York, New York

Home blood glucose monitoring with Chemstrip bG

1. Wash your hands with soap and water.

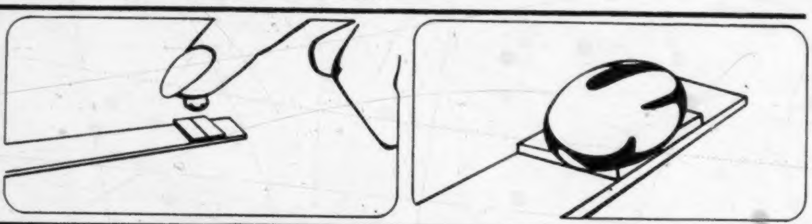


2. Prick the side of the finger using a lancet or a finger pricking device such as the Autoclix.®

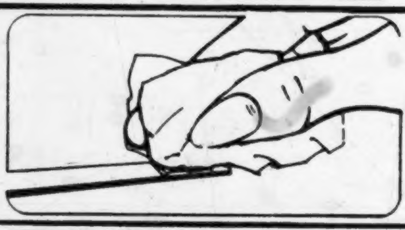


3. Obtain a large hanging drop of blood and apply the blood to both reaction zones of the Chemstrip bG.

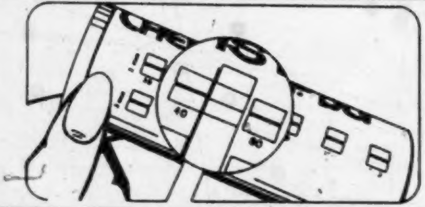
   N.B.: Do not smear blood. Ensure both reaction patches are covered.



4. After exactly 60 seconds, wipe the blood from the strip using a white tissue. Use moderate pressure only.

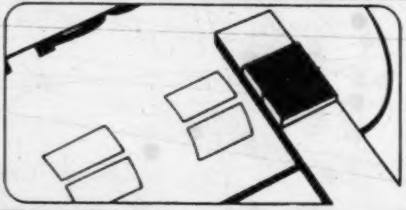


5. Wait another 60 seconds, and compare colour of strip with the vial label. It may be necessary to interpret between label colours.



For example, the bottom (blue) square matches 40 mg/dL (2.2 mmol/L) while the top (green) square matches 80 mg/dL (4.4 mmol/L). The result would be 60 mg dL (3.3 mmol/L).

6. If results are darker than the last colour block on the top line after the second minute, wait one minute longer before comparing the final colour.



7. Record results in the diabetic diary.

For more information, or your free copy of the Diabetic Diary call or write:

Boehringer Mannheim Canada Limited
11450 Cote de Liesse
Dorval, Quebec
H9P 1A9
(514) 636-6760

TS E 68 12/12/84

GUIDELINES FOR THE USE OF CHEMSTRIP bG*

PURPOSE: To determine the blood glucose value of a capillary blood sample.

GENERAL INFORMATION: Chemstrip bG is a firm plastic strip with two separate areas having different sensitivities towards glucose.

EQUIPMENT: Chemstrip bG
Alcohol swab (optional)
Blood letting device (i.e. Autolet**, Penlet***)
Watch with a seconds function
White tissue

PROCEDURE:

1. Explain the procedure to the patient.

2. Confirm that the Chemstrip bG are within the expiration date shown on the container label.

3. (a) Ambulatory patient - Instruct the patient to wash his hands with warm water and soap, and to dry his hands thoroughly.

   (b) Non-ambulatory patient - Wipe the area to be punctured with an alcohol swab and allow the area to air dry; or wash with warm water and soap and dry thoroughly.

4. Instruct the patient to hang his arm at his side for 30 seconds to promote blood flow to the fingertips.

5. Resting the patient's finger against a firm surface, prick the side of the fingertip using an automatic blood letting device.

6. Turn the patient's hand over. Lightly squeeze fingertip, let go, repeat several times until a large droplet of blood has formed.

7. Wipe away the first drop of blood that appears, using a white tissue. This is to avoid mixing tissue fluid with the blood sample for testing. If there is difficulty in obtaining a drop of blood, the first droplet may be used.

8. Apply a large drop of blood sufficient to cover both reagent areas. Do not smear or cover too thinly.

9. Wait exactly 60 seconds. then wipe off the blood with a clean tissue. Ensure that the blood has been completely removed.
   NOTE: Never use gauze to remove the blood droplet from the strip. Do not use colored tissue as the dye will interfere with the enzyme in the reagent pad.

10. Wait an additional 60 seconds.

11. Match the two colours of the treated area separately to the colour chart on the Chemstrip bG container.

12. If values exceed 16.7 mmol/L wait an additional 60 seconds and then compare colours to the Chemstrip bG container.

13. If the colours fall between the colour blocks, interpolate by adding the values on either side and dividing by two, i.e., if the colour falls between 8.9 mmol/L and 11.1 mmol/L the blood glucose value is approximately 10.0 mmol/L.

NOTE:

1. Replace the container cap immediately after removing a strip and store at a temperature under 30 degrees Centigrade as humidity, direct sunlight, and extremes of temperature will affect the enzymatic reaction.

2. Never transfer unused strips to another container.

3. Never use a colour chart from a different container.

4. Capillary blood glucose values may be 10-20% lower than the laboratory values as whole blood glucose is being measured rather than plasma glucose.

5. The glucose value is stable at room temperature for up to 4 hours.

DOCUMENTATION

Record the result in mmol/L on the Diabetes Record and enter the exact time the test was completed. Inform the physician of the result as ordered and/or as indicated by the patient's condition.

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* Registered Trademark - Boehringer Mannheim Canada Ltd.
** Registered Trademark - Ulster Scientific Inc., New York, New York.
*** Distributed by LifeScan Inc. Mountain View, CA.

TROUBLESHOOTING CHEMSTRIP bG

PROBLEM	CHEMSTRIP bG
Underestimation	Smeared blood Inadequate amount of blood Inaccurate timing. Poor lighting. Contaminated strip.*
Overestimation	Inaccurate timing. Poor lighting. Contaminated strip.*
Widely separated colors	More than one drop of blood applied. More blood on one pad than the other. Cut strips Contaminated strips.*
Non-distinct	Smeared colors.
Mottled Colors	Contaminated strips.*

*Overexposure to heat/cold/light, or humidity.

Remember:

1. Use only cotton or soft tissue
2. Keep the vial closed.
3. Be sure the puncture site is dry before lancing.

APPENDIX B

Nurses Informed Consent

Project Title - Reliability of the Chemstrip Procedure by Staff Nurses

Investigator(s) Name: Kathleen O'Neill Masters of Nursing Candidate
Research Chairperson: Dr. Janet Kerr
University of Alberta
MN Program
Agency: Misericordia Hospital

This is to certify that I, ______________________________ hereby agree to participate in the research project investigating the effect of a certification program for nurses on the reliability of their performance of the visual chemstrip procedure.

I have read and understand the attached letter describing the methodology of the study and have been given the opportunity to ask whatever questions I desire and all such questions have been answered to my satisfaction.

I understand that in no way am I compelled to participate in this study and that non-participation will not in any way affect employment status. I also understand that I am free to withdraw from the study at anytime.

I understand that anonymity will be maintained in relation to individual results by the use of numbers instead of names in the data charts.

I understand that the results of the study will be made available to me if I wish (circle below).

I wish to be informed of the study results. Yes No

____________________	____________________	____________________
Signature of Participant	Subject Code Number	Date

____________________	____________________
Witness	Occupation of Witness

MISERICORDIA HOSPITAL
Edmonton, Alberta

PATIENT
CONSENT FOR PARTICIPATION IN A RESEARCH PROJECT

Described below is an outline of a research project. The names of the principle investigators are indicated. It is important that the nature of the project be explained in order that you understand what part you will play. This should include an understanding of the probable risks involved, any side effects to be expected and alternative established methods of treatmen After reading the summary below and having the investigator explain the project and answer any questions you may have, your witnessed signature is required, attesting that you understand the project.

It is also understood that you may withdraw from the study at any time by notifying the attending physician and/or the investigator.

If the administration of drugs or surgical procedures are involved, you will be required to sign a more detailed consent form for their use.

Title: Reliability of the Chemstrip Procedure by Staff Nurses. Project:

Investigators: Kathleen O'Neill MN Candidate   Dr. Janet Kerr, Research Chairperson

Outline of Project (Purpose, methods, principle risks involved): The purpose of the study is to assess the effects of an educational program on the reliability of the chemstrip procedure by nurses. Eventually this study will assist in ensuring that the chemstrip procedure by nurses is safe and accurate. About 100 nurses will be assigned to two groups; 50 to one group, 50 to the other. One group will receive the educational program, the other group will not. The reliability check of both groups will follow and this involves every nurse from both groups doing two chemstrip recordings on patients who have blood sugar ordered by their doctor. The results will then be analyzed and the two groups compared. There are no known risks to this procedure. However, in some situations the chemstrip procedure which is done on the patient may be over and above that which is required for standard patient care.

I understand the above statement and agree to participate in the project:

PATIENT   **WITNESS**

Name   Name

Signature   Date   Signature

If patient is under the age of majority (18) or has been declared a Dependent Adult under the Dependent Adult Act, the written consent of the legal guardian is required.
Please complete the following:
The patient is unable to consent because:

Legal Guardian   Date   Witness

Withdrawal From a Study: I hereby Withdraw my consent for continued participation in the study.

Patient or Legal Guardian   Date   Witness

123/1279

APPENDIX D

16402 - 88 Avenue
Edmonton, Alberta

21 Aug. 1987

Dear ,

The purpose of this letter is to request your participation in a research study which will commence on the medical units in the near future. This study is being done as my Masters of Nursing thesis.

The objective of the study is to determine the effects of a certification program on the reliability of the chemstrip procedure by staff nurses and is also part of a quality control program for capillary blood glucose monitoring by staff nurse.

The project requires approximately one hundred nurses who will be randomly assigned to an experimental or a control group. The experimental group will receive a certification program for the visual chemstrip procedure which will take approximately one hour and will be administered by the NCC's. The reliability check will follow and involves every nurse in both groups doing two chemstrip recordings on patients who have a blood glucose ordered by the physician. The chemstrips will be done within one minute of the glucose being drawn by the laboratory staff . The chemstrip and laboratory result will then be compared and statistical analysis will be done to determine differences between the experimental and control groups in terms of reliability recordings.

This study will provide data which will improve the practice of nursing and enhance the quality of care for patients. Therefore your participation in this study will contribute to this goal.

If you have any questions or would like more information please call the undersigned at 484-7275 or contact your unit supervisor or NCC. I will also be available for information sessions as required. Otherwise, the consent, form is attached; I would ask that you read it and sign if you choose to participate. Please return the signed witnessed consent form to your unit supervisor as soon as possible.

Thank you for your interest and support. I will be in further contact with you as the study proceeds.

Kathleen O'Neill
Masters of Nursing Candidate

16402 - 88th Avenue
Edmonton, Alberta
T5R 4M7

September 24th, 1987

Dear

Thank you for agreeing to participate in this nursing research project. Your interest and support are much appreciated.

Your code number in the study will be . From this point on all information and other data will be recorded per this code number thus ensuring your anonymity.

The following steps are outlined for your information and direction relative to your participation in the study.

1) Arrange a date and time to take the certification program. This can be done by contacting your nursing care co-ordinator or unit supervisor to arrange a mutually acceptable time. The certification program will be administered by the nursing care co-ordinators and will take approximately one hour. *Please note that all nurses at the Misericordia will soon require certification for the chemstrip procedure.*

The time frame we have set for this step is approximately four (4) weeks; therefore your certification ought to be completed between October 5th and November 2nd.

2) Once you have been certified for the chemstrip procedure you may proceed to the next step. This step involves each nurse doing two chemstrips on patients who have blood glucose or Elect, BUN, Gluc. (SMA-6) ordered.

a) Choose a patient who has blood glucose or Elect, BUN, Gluc. (SMA-6) ordered. (fasting or non-fasting).
b) Contact the laboratory 1 day in advance if possible to inform them that you wish to do the concurrent chemstrip and to notify the desk when they reach the nursing unit.
c) Obtain the patients informed consent (patient consent forms are attached).
d) After the lab technician has drawn the blood specimen do the chemstrip within one minute.
e) Record the result of the chemstrip and other data on the data collection form. (2 are attached)
f) After the chemstrip result and other data are recorded fold the form and place it in the container in the unit classroom labelled "chemstrip study".
g) As well, place the signed consent form in the file folder in the unit classroom labelled "Patients Consent Chemstrip Study".
h) When each nurse has done two chemstrips by this process her participation in the study is complete.

The time frame we have set for this step of the study is approximately five (5) weeks. Therefore, Step II ought to be completed between October 12th (or sooner if certified) and November 16th.

2 . . .

The laboratory blood glucose result will be obtained by the undersigned working in conjunction with the unit supervisor of biochemistry.

There will be additional data forms and patient consent forms in a file folder in the unit classroom if you lose the attached.

I would like to thank you once again for participating in this study. It is recognized that this participation involves time and commitment. If there are any questions or concerns please feel free to call me at 484-7275 or contact your unit supervisor or nursing care co-ordinator.

You will be notified of the study results as requested.

Sincerely,

Kathy

Kathy O'Neill
MN Candidate

KO:jme
Encl.

APPENDIX F

16402 - 88th Avenue
Edmonton, Alberta
T5R 4M7

September 24th, 1987

Dear

Thank you for agreeing to participate in this nursing research project. Your interest and support are much appreciated.

Your code number in this study will be . From this point on all information and other data will be recorded per this code number, thus ensuring your anonymity.

The following steps are outlined for your information and direction, relative to your participation in the study.

1) choose a patient who has a blood glucose or Elect, BUN, Gluc. (SMA-6) ordered (fasting or non-fasting).
2) Contact the laboratory 1 day in advance if possible to inform them that you wish to do a concurrent chemstrip and to notify the desk when they reach the nursing unit.
3) Obtain the patients informed consent (patient consent formsare attached).
4) After the laboratory technician has drawn the blood specimen do the chemstrip within one minute.
5) Record the results of the chemstrip and other data on the data collection form. (2 are attached)
6) After the chemstrip result and other data is recorded fold the form and place in the container in the unit classroom labelled "chemstrip study".
7) As well place the patient's signed consent form in the file folder in the unit classroom labelled "Patients Consent Chemstrip Study".
8) When each nurse has completed two chemstrips by this process her participation in the study is complete.

The time frame which has been set for this process is four (4) weeks. Therefore, your participation ought to be completed between October 5th and November 2nd.

Please note: The laboratory blood glucose result will be obtained by the undersigned working in conjunction with the unit supervisor of biochemistry.

There will be additional data forms and patient consent forms in the file folders in the unit classroom if you lose the attached.

I would like to thank you once again for agreeing to participate in this study. It is recognized that this participation involves time and commitment on your part. If there are any questions or concerns please feel free to call me at 484-7275 or contact your unit supervisor or nursing care coordinator.

You will be notified on the study results as requested.

Sincerely,

Kathy

Kathy O'Neill

KO:jme

APPENDIX G

Data Collection Form **Patients Addressograph Plate**

Nurses Code Number ____________________

Date ____________________

Time ____________________

Chemstrip Result ____________________